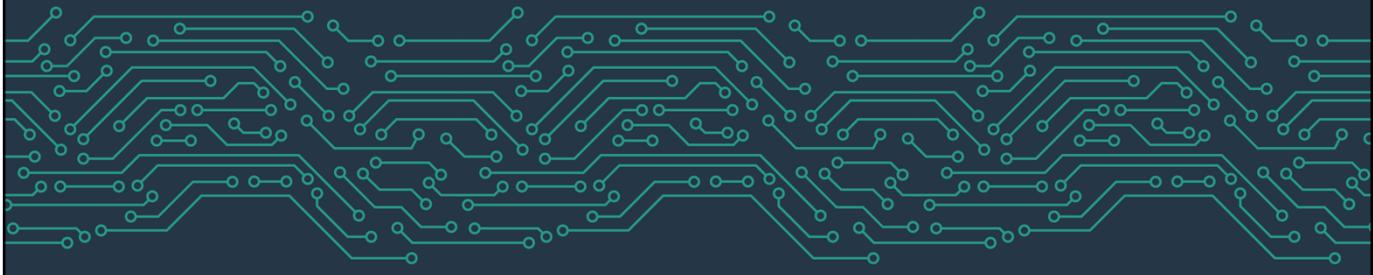




Tiny Containers

Exploring the World of Docker and Kubernetes with a Raspberry Pi Cluster

Mark Ramsey
@mramsey24



Hello!

Mark Ramsey
@mramsey24

- Tech Consultant @ Nationwide
- 20+ years development experience
- COBOL to SmallTalk, with a whole lot of Java
- Raspberry Pi, IOT enthusiast

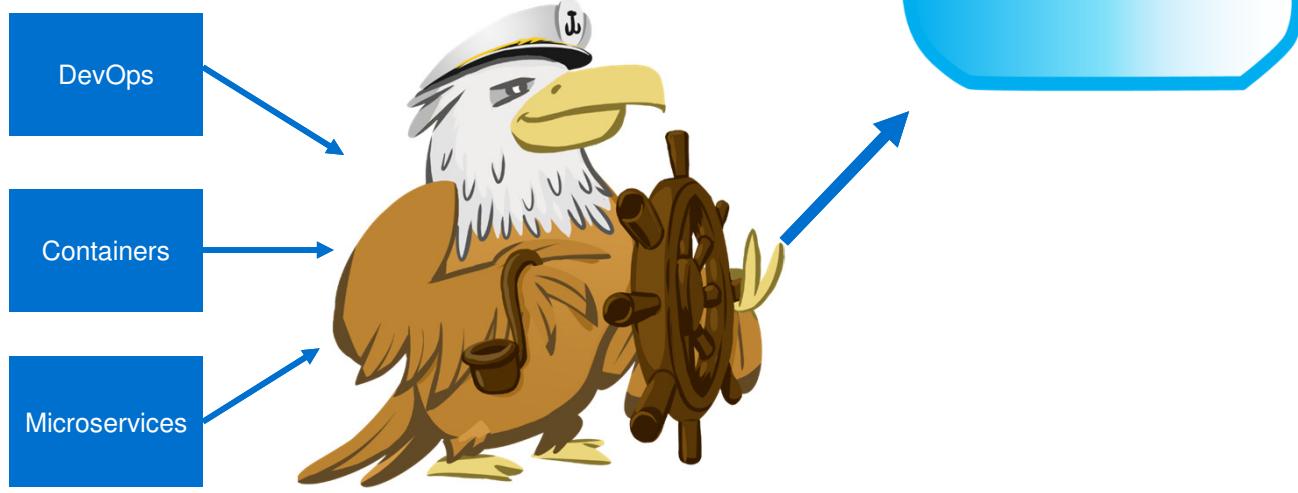


The Challenge

Technology Shifts → Learning



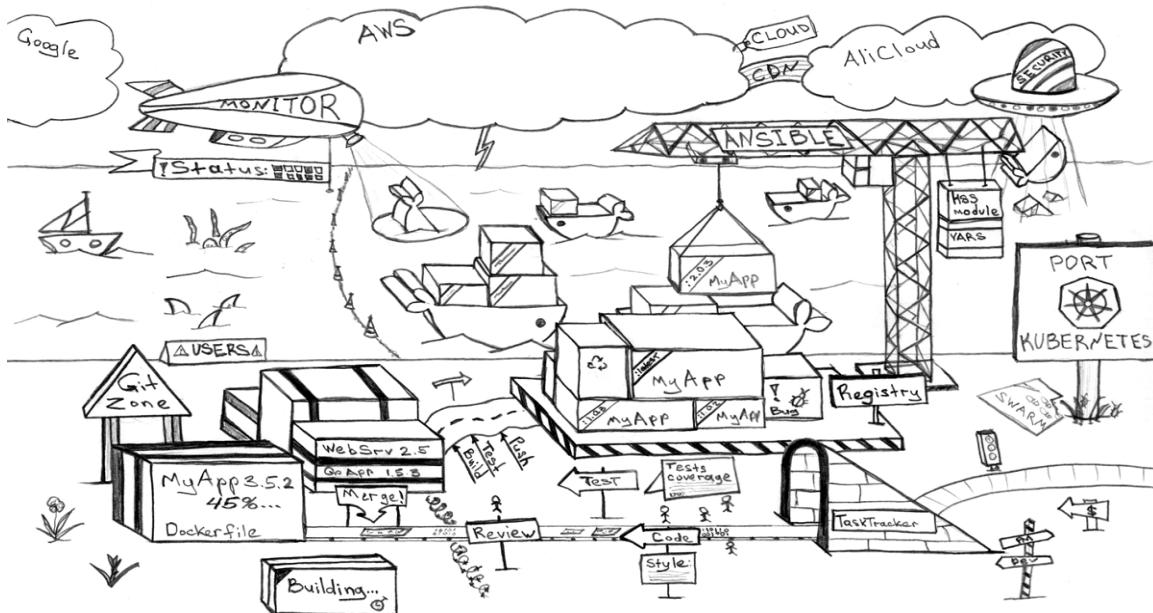
Cloud Journey



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<https://hackernoon.com/the-best-architecture-with-docker-and-kubernetes-myth-or-reality-77b4f8f3804d>



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<https://www.cncf.io/>

Sustaining and Integrating
Open Source
Technologies

The Cloud Native Computing Foundation builds sustainable ecosystems and fosters a community around a constellation of high-quality projects that orchestrate containers as part of a microservices architecture.

CNCF serves as the vendor-neutral home for many of the fastest-growing projects on GitHub, including Kubernetes, Prometheus and Envoy, fostering collaboration between the industry's top developers, end users, and vendors.

50,399 # of contributors to CNCF projects

60,610 Registered for free Kubernetes EdX

79 Certified Kubernetes

95,912 CNCF Meetup members

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CNCF Cloud Native Landscape
2019-03-04T23:52:24Z 0942949

See the interactive landscape at l.cncf.io

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 **CLOUD NATIVE
TRAIL MAP**

The Cloud Native Landscape [Landscape](#) has a large number of options. This Cloud Native Trail Map is a recommended process for leveraging open source, cloud native technologies. At each step, you can choose a vendor-supported offering or do it yourself, and everything after step #3 is optional based on your circumstances.

HELP ALONG THE WAY

A. Training and Certification
Consider training offerings from CNCF and then take the exam to become a Certified Kubernetes Administrator or a Certified Kubernetes Application Developer [cncf.io/training](#)

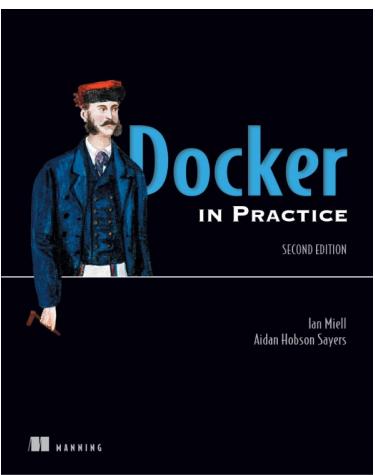
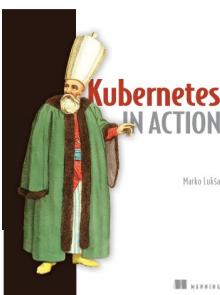
B. Consulting Help
If you want assistance with Kubernetes and the surrounding ecosystem, consider leveraging a Kubernetes Certified Service Provider [cncf.io/kcsp](#)

[CLOUD NATIVE LANDSCAPE](#)

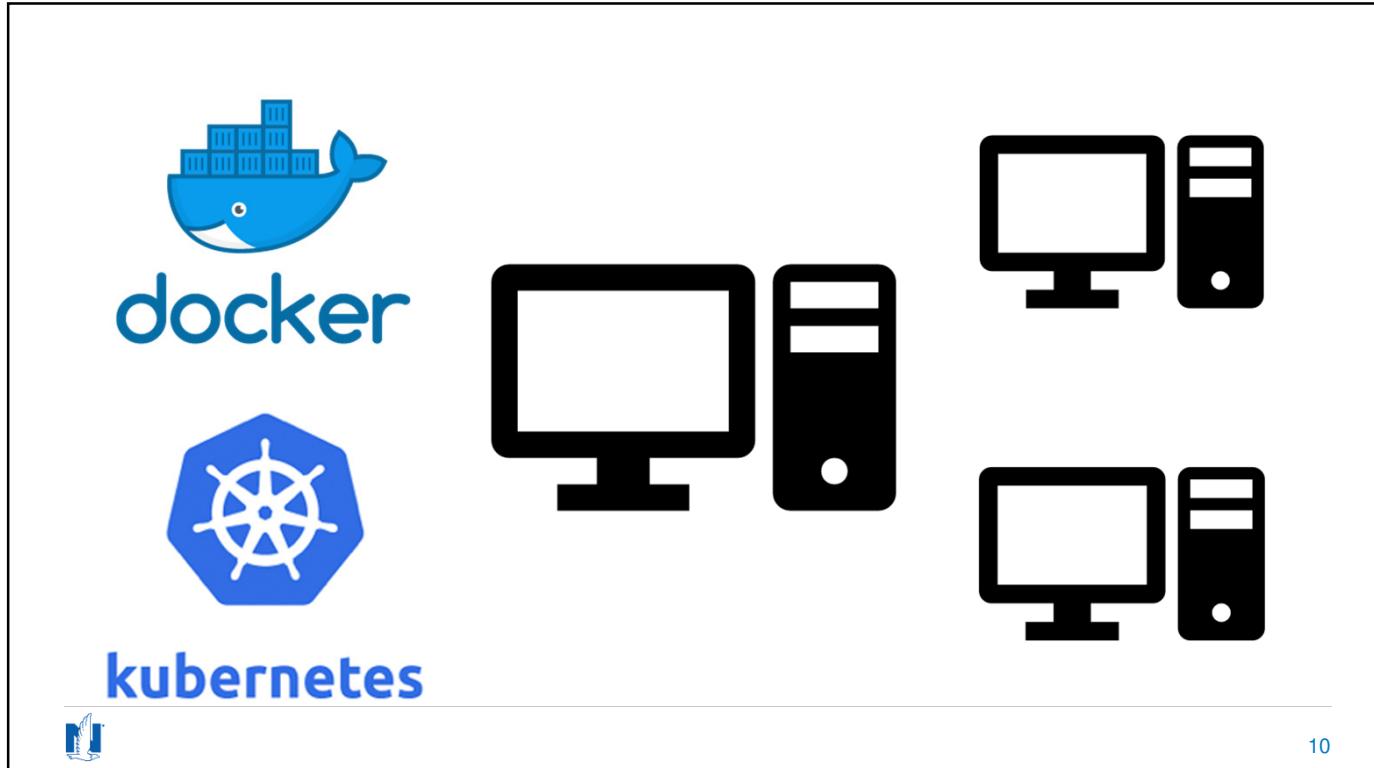


<https://github.com/cncf/landscape>

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Personal Cloud Requirements

Low cost

Easy to build
(and rebuild)

Provide rapid
feedback

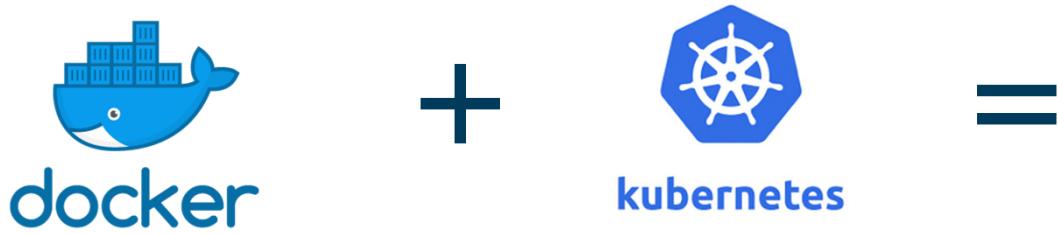
Leverage
Docker and
Kubernetes

Can deploy
containerized
apps

Portable

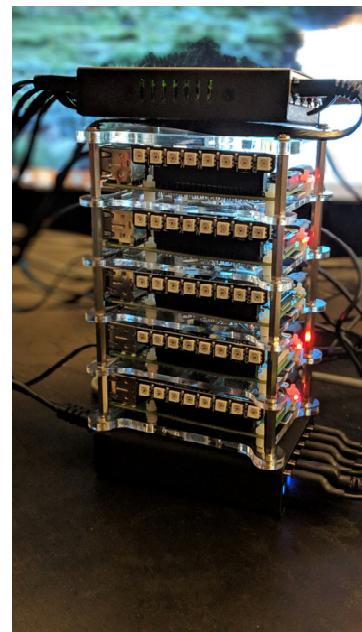


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Docker + K8S

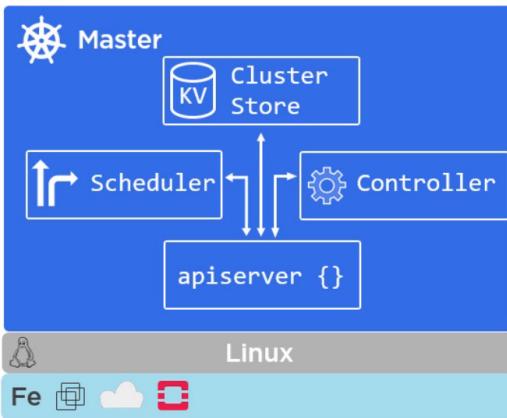
30,000 Feet



<https://blog.docker.com/2016/09/dockerforws2016/>

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Server Node(s)



Apiserver

- Front end to the control plane
- Exposes the REST API
- Consumes JSON

Cluster Store

- Persistent storage
- Cluster state and config
- Uses etcd (key value store)

Controller Manager

- Watches for changes
- Helps maintain desired state

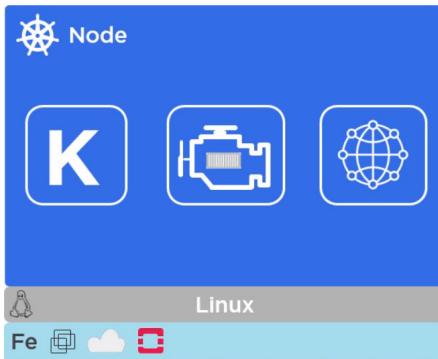
Scheduler

- Watches apiserver for new pods
- Assigns work to nodes

<https://app.pluralsight.com/library/courses/getting-started-kubernetes>

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Worker Nodes



Kubelet

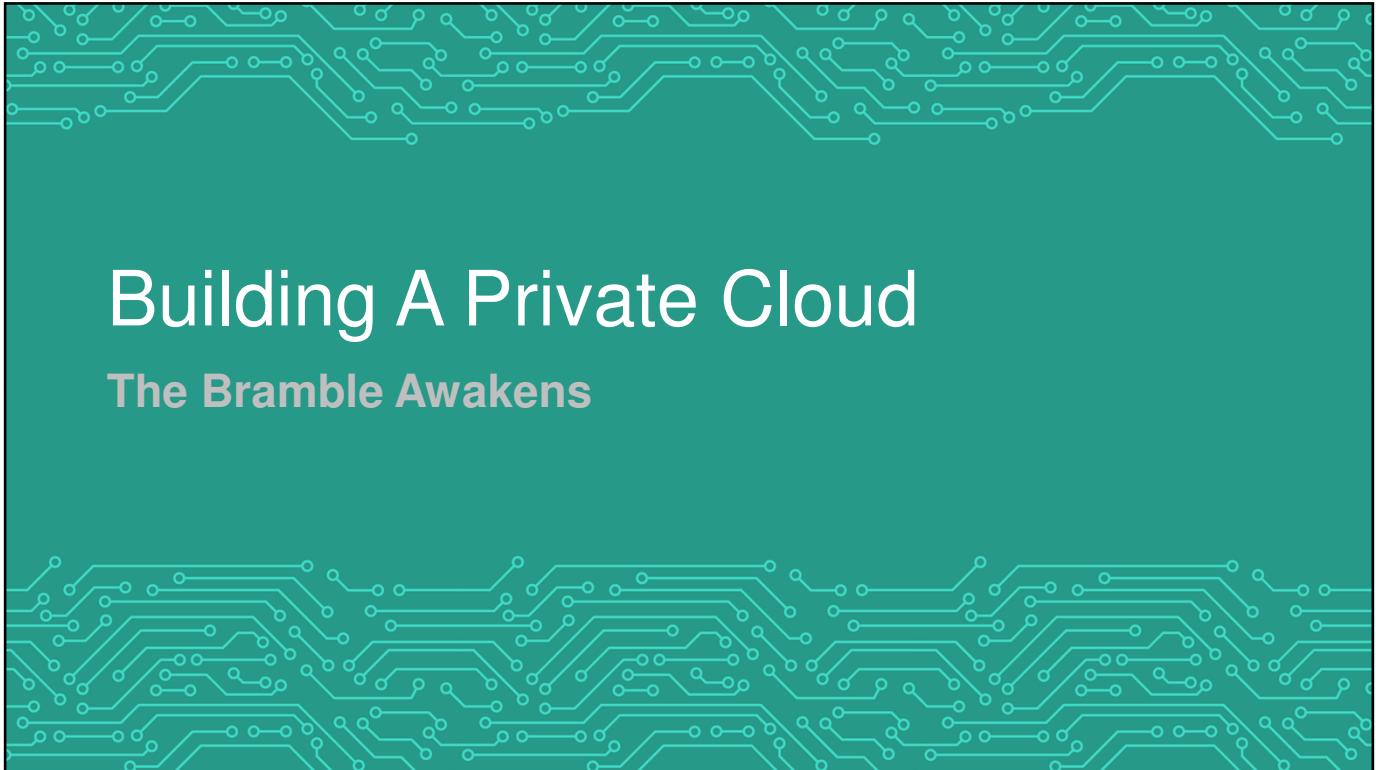
- The main K8S agent
- Registers node with cluster
- Watches apiserver
- Instantiates pods
- Reports to master

Container Engine

- Does container management
 - Pull images
 - Starting /stopping containers
- Pluggable
 - Docker or rkt

<https://app.pluralsight.com/library/courses/getting-started-kubernetes>

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Building A Private Cloud

The Bramble Awakens

Build your own bare-metal ARM cluster

22 DECEMBER 2018 on open source, kubernetes, swarm, arm, Raspberry Pi, serverless

In this blog post we'll explore how to build your very own bare-metal ARM cluster that you can run 24/7 at home for very little cost. There are many different ARM System on Chip (SoC) boards available so it can be a confusing space or an unfortunate time-sink. In this post I'll explore some important terminology for ARM and explain some of the practicalities in buying this type of equipment to build clusters. Don't worry - I will be giving you a bill of materials.

When you have the fundamentals in place we'll then deploy cloud native software that can help you learn about distributed and cloud computing such as Kubernetes and Docker Swarm. The primary goals of this post are to raise awareness for working with ARM hardware and to help you build a tangible, educational project that you can develop over time.

Alex Ellis
@alexellisuk

Anyone want to submit a talk about their shiny @Raspberry_Pi
+ @OpenFaas cluster? KubeCon CFP deadline is today -
DockerCon is on 15th. Willing to review / help for these events
or others. 🤘 #DockerCaptain

<https://blog.alexellis.io/build-your-own-bare-metal-arm-cluster/>

SCOTT HANSELMAN

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How to Build a Kubernetes Cluster with ARM Raspberry Pi then run .NET Core on OpenFaas

October 28, 2017 | Comments [18] | Posted in Open Source

First, why would you do this? Why not. It's awesome. It's a learning experience. It's cheaper to get 6 pis than six "real computers." It's somewhat portable. While you can certainly quickly and easily build a Kubernetes Cluster in the cloud, there's something more visceral about learning it this way, IMHO. Additionally, it's a non-trivial little bit of power you've got here. This is also a great little development cluster for experimenting. I'm very happy with the result.

By the end of this blog post you'll have not just Hello World but you'll have Cloud Native Distributed Containerized RESTful microservice based on ARMv7 w/ k8s Hello World! as a service. (original Tweet.)

Not familiar with why Kubernetes is cool? Check out Julia Evans' blog and read her K8s posts and you'll be convinced!

HARDWARE LIST (SCROLL DOWN FOR SOFTWARE)

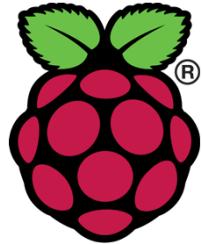
Here's your shopping list. You may have a bunch of this stuff already. I had the Raspberry Pis and SD Cards already.

<https://www.hanselman.com/blog/HowToBuildAKubernetesClusterWithARMRasperryPiThenRunNETCoreOnOpenFaas.aspx>

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Raspberry Pi 3 B+



CPU: Quad Core ARM @ 1.4Ghz

RAM: 1 GB

Networking: Gigabit Ethernet (via USB channel), 2.4GHz and 5GHz 802.11b/g/n/ac Wi-Fi

Bluetooth: Bluetooth 4.2, Bluetooth Low Energy (BLE)

Ports: HDMI, 3.5mm analogue audio-video jack, 4x USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI)

Cost: \$35



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Black Box LBS008A USB-Powered
10/100 8-Port Switch



Portable Router

Tenda N301
WISP mode



Samsung 32GB EVO Plus Class
10 Micro SDHC with Adapter
80mb/s (MB-MC32DA/AM)



Anker PowerPort 6 (60W 6-
Port USB Charging Hub) + [6-
Pack] Premium 1ft Micro USB
Cables



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Base Setup (All Nodes)

1. Download **Raspbian Lite** and flash to SD Card ([Etcher.io](#))
2. Create an empty **ssh** file on the root of the SD card
3. Boot the Pi
4. SSH into the Pi
5. Use **raspi-config** to change settings
 - Change machine name
 - Change password
 - Expand filesystem
 - Change video memory



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Kubernetes Setup (last week's method)

1. Install and Configure Docker on all Nodes
2. Install Kubernetes on all Nodes
3. Use 'kubeadm' to initialize the Master Node
4. Store the output of Step 3
5. Use 'kubeadm' on each Worker Node to join the Master Node



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K3s - 5 less than K8s

- Lightweight Kubernetes. Easy to install, half the memory, all in a binary less than 40mb.
 - Great for:
 - Edge
 - IoT
 - CI
 - ARM **← Raspberry Pi goodness!!!**
 - “Situations where a PhD in k8s clusterology is infeasible”
- * <https://k3s.io/>



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Kubernetes....in less than a minute!

```
# Install K3S on the master/server node  
k3sup install --ip $SERVER --user pi  
  
# Where $SERVER is the ip address of your master/server node
```

```
# Install K3S on the worker nodes  
k3sup join --ip $AGENT --server-ip $SERVER --user pi  
  
# Where $SERVER is the ip address of your master/server node  
# and $AGENT is the ip address of the worker node
```



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Running Your Own Cloud It Ain't Just for DataCenters

Pi = Kubernetes Node



MCR
TRON-1
TRON-2
TRON-3
TRON-4



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Meet K8-S1

DEMO TIME



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Next Steps

Build a
bigger one!

Use Pi 4s

Ansible

Netbooting

Home
Assistant

Concourse

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Resources

<https://github.nwie.net/Nationwide/tiny-containers>

<https://www.cncf.io/>

<https://github.com/cncf/landscape>

<https://blog.docker.com/2016/09/dockerforws2016>

<https://app.pluralsight.com/library/courses/getting-started-kubernetes>

<https://blog.alexellis.io/build-your-own-bare-metal-arm-cluster/>

<https://www.hanselman.com/blog/HowToBuildAKubernetesClusterWithARMRaspberryPiThenRunNETCoreOnOpenFaaS.aspx>

<https://k3s.io/>

<https://github.com/alexellis/k3sup>

<https://shop.pimoroni.com/products/blinkt>



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Q&A



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Appendix Legacy Installation Steps

Legacy - Install Docker (all nodes)

```
# Execute docker install script and add pi user to
# docker global group
curl -sSL get.docker.com | sh && sudo usermod pi -aG
docker

# Switch to the docker group
newgrp docker

# Verify Docker is installed
docker --version
```



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Legacy - Install K8S (all nodes)

```
# Install K8S
$ curl -s https://packages.cloud.google.com/apt/doc/apt-key.gpg | sudo apt-
key add - && \
echo "deb http://apt.kubernetes.io/ kubernetes-xenial main" | sudo tee
/etc/apt/sources.list.d/kubernetes.list && \
sudo apt-get update -q && \
sudo apt-get install -qy kubeadm

# Verify kubeadm is installed
$ kubeadm

# Verify kubectl is installed
$ kubectl
```



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Legacy - Configure K8S Master Node

```
# Set up the Master Node (takes awhile)
sudo kubeadm init --apiserver-advertise-address=192.168.1.174

# IMPORTANT: Capture the output of this command. It has the key you need
to join the cluster
```



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Legacy - Configure K8S Worker Nodes

```
# Join the cluster (workers)
# This command is generated when you install K8S
# Replace the IP with the IP of your master node
kubeadm join 192.168.1.174:6443 --token q44kc9.t6fjli2jkvrtqz1h --
discovery-token-ca-cert-hash
sha256:665ae675c7f19e32cd4999350cd0b54f70b4cd2429f3259d918ac1e96c630cf2
```



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