Yocto Continuous Integration In a Kube

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Embedded Linux Conference

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About Me

- Worked at Garmin since 2009
- Using OpenEmbedded & Yocto Project since 2016
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- JPEWhacker@gmail.com
- IRC (OFTC or libera): JPEW
- Twitter: @JPEW_dev
- LinkedIn: joshua-watt-dev

Development Pipeline

```java
private static final String[] natoCalls = {
    "Alpha", "Bravo", "Charlie", "Delta", "Echo",
    "Foxtrot", "Golf", "Hotel", "India", "Juliet",
    "Kilo", "Lima", "Mike", "November", "Oscar",
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public static String getNATOCall(char letter){
    if(letter >= 'a' && letter <= 'z'){
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    }
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```
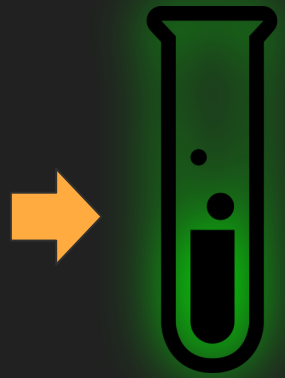



Code

Build

Test

Deploy

PR Server

Hash Equivalence Server

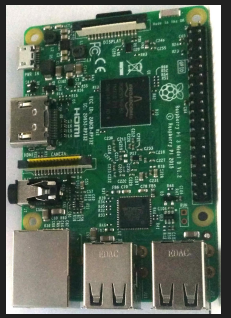
```
1 private static final String[] natoCalls = {
2
3
```

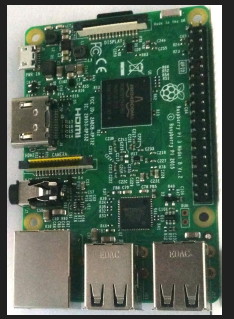
Download cache NFS Server

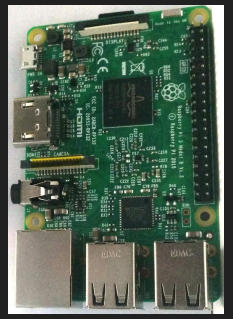
Download cache HTTP Server

sstate NFS Server

sstate HTTP Server







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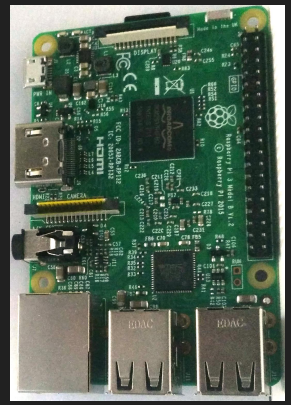


Code

Build, Test, & Ancillary Services

Deploy

Kubernetes Advantages

- Runs in many environments
- Standardized descriptions
- High availability
- Reliability
- Scheduling

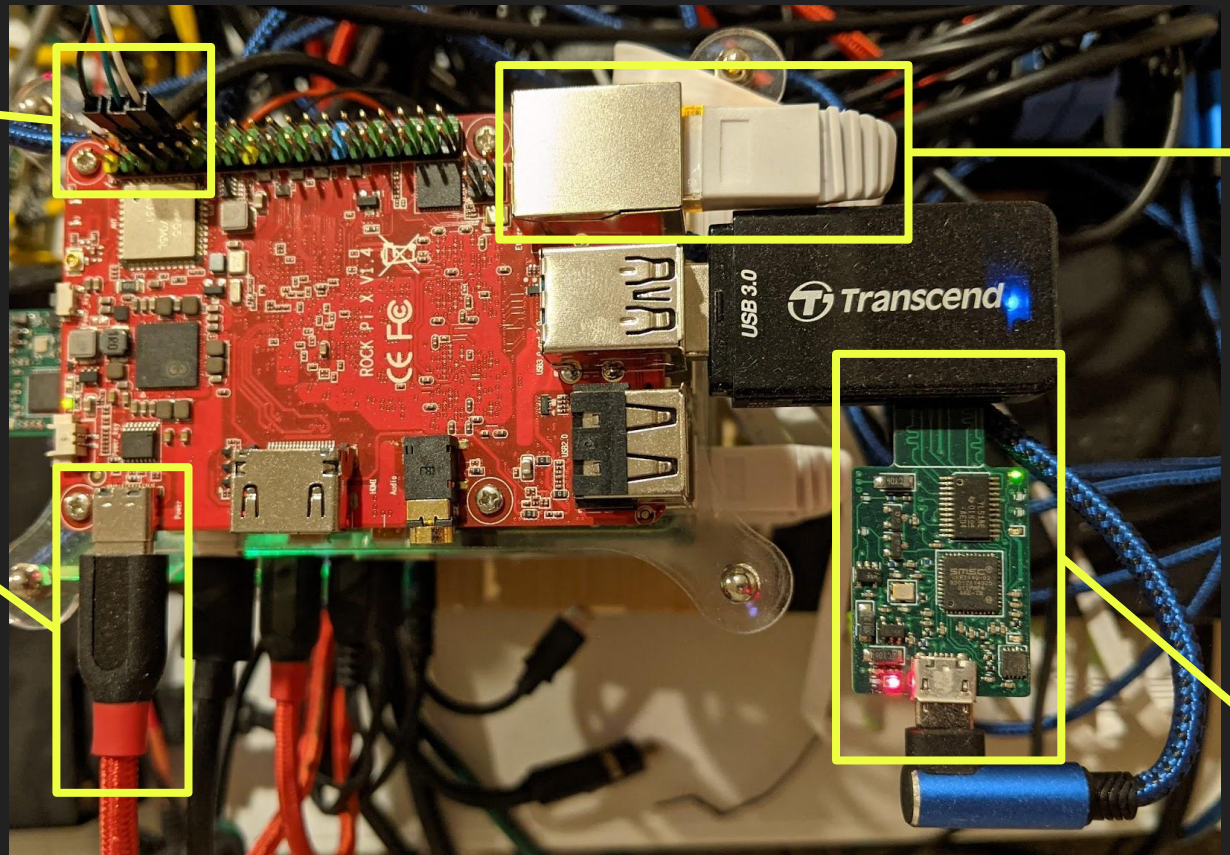
The Hardware

The Test Cluster

- Rock Pi X
- Raspberry Pi 4
- Rock Pi 4
- Raspberry Pi 3
- Asus Tinkerboard
- Pine H64
- IMX8M Pico Pi (Not connected)

All connected via USB to a mini PC

Control Interface



(reverse)

Control PC

Ethernet Switch

16 Port
USB Hub

Meticulous Wire
Organization

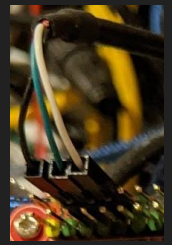
Relay Controlled
Outlets (8)

USB Relay

Extra Raspberry Pi…
connected to nothing?

Testing Strategy

1. Turn Off Power
2. Use the SDWire to attach the SD card to the PC
3. Write Image to SD Card
4. Use the SDWire to attach the SD card to the board
5. Turn On Power
6. Monitor boot via USB serial adaptor
7. SSH into device to test networking

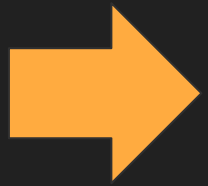


My Kubernetes Cluster

Dell R610 x 3

- 12c/24t Xeon X5670 @2.93 GHz
- 70 GB RAM
- 1 TB HDD
- 1 GbE x4 networking (w/ LCAP)
- Ubuntu Server

```
$ kubectl get nodes
NAME        STATUS   ROLES                  AGE   VERSION
galactica   Ready    control-plane,master   43d   v1.21.1
starbuck    Ready    <none>                 43d   v1.21.1
viper       Ready    <none>                 43d   v1.21.1
```

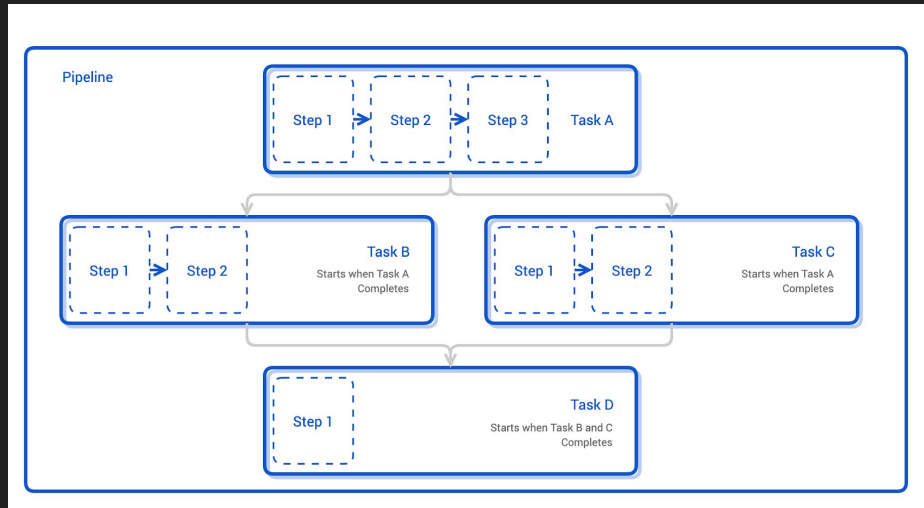


TEKTON

LAB GRID

What is Tekton?

- Cloud Native Framework for CI/CD
- All definitions are Kubernetes resources
- Constructs Pipelines from Tasks
- Each Task is a Kubernetes pod (group of containers)
- https://tekton.dev/



What is Labgrid?

- Board farm management
- Python interface library
- Python pytest integration for writing tests
- Clients talk to the board farm via SSH
- https://labgrid.readthedocs.io/en/latest/

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Code

TEKTON

CROPS

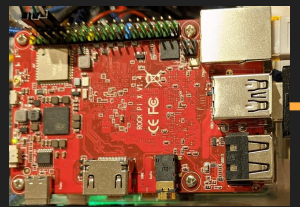
Build

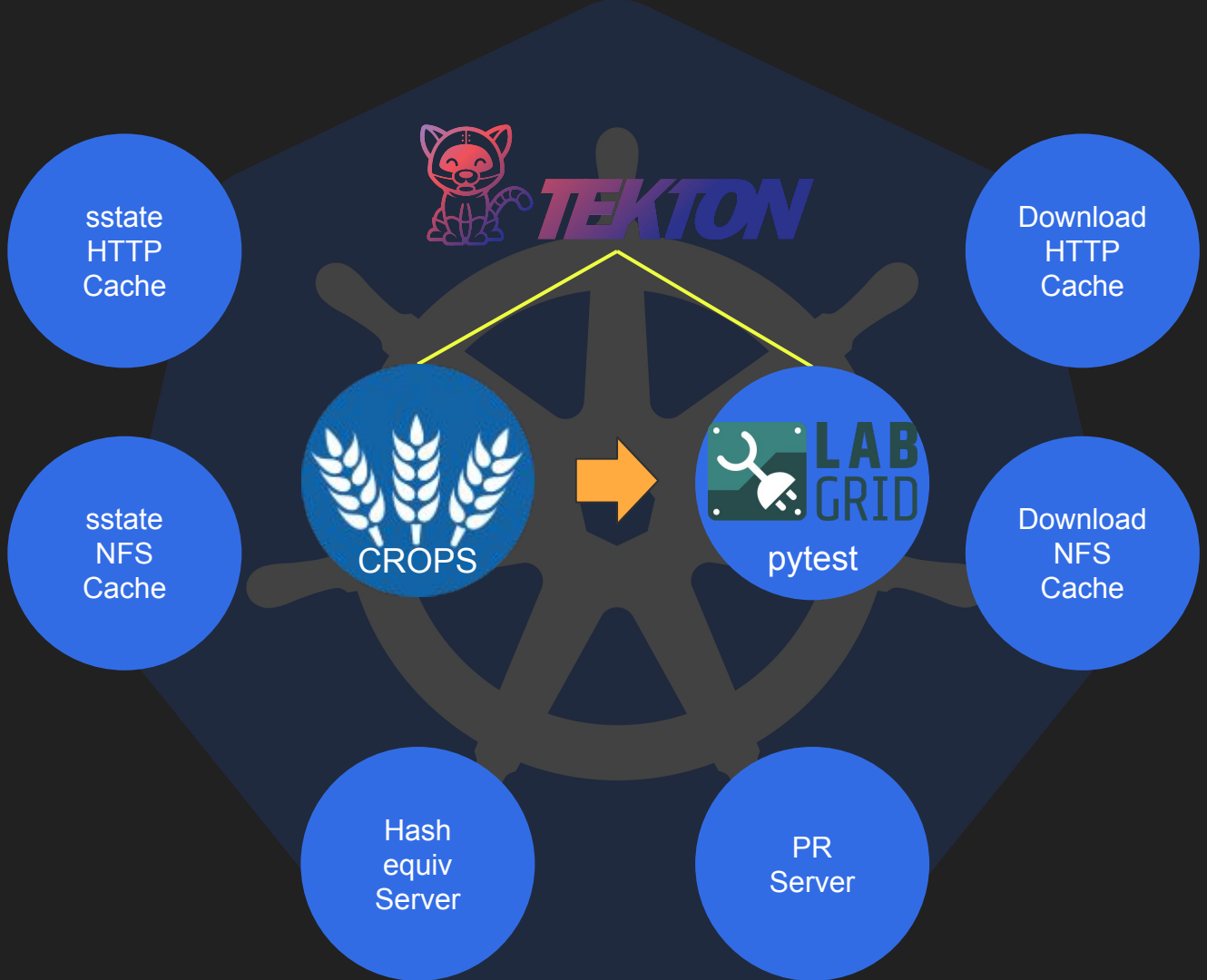
LAB GRID

pytest

Test

SSH

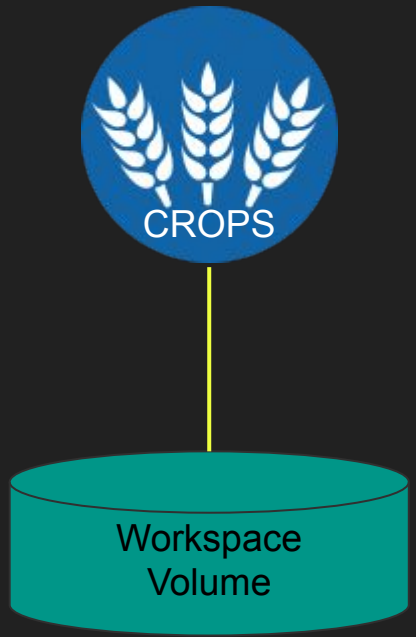



TEKTON
sstate
HTTP
Cache
sstate
NFS
Cache
Hash
equiv
Server
Download
HTTP
Cache
Download
NFS
Cache
PR
Server
CROPS
LAB
GRID
pytest

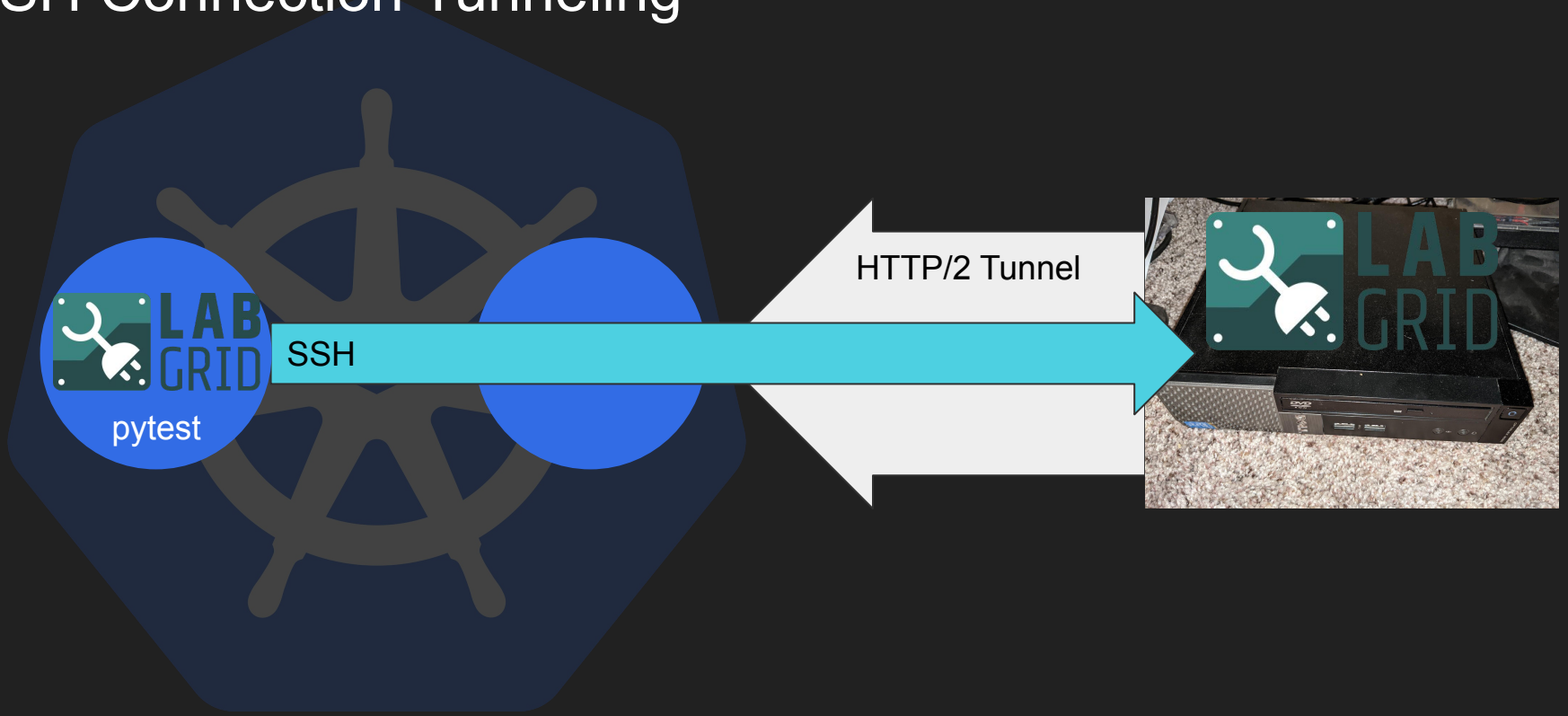
Workspace Volumes

A workspace volume should be attached

- Tried NFS (made bitbake unhappy)
- Tried CEPH (too slow)
- Ended up using Local Persistent Volumes



SSH Connection Tunneling



https://github.com/mmatczuk/go-http-tunnel

The Code

- https://github.com/JPEWdev/yocto-doom-demo
- Builds image that run a selection of DOOM-based games on boards in my cluster
- Uses whisk (https://github.com/garmin/whisk) to build against multiple versions of Yocto
  - gatesgarth (Yocto 3.2)
  - hardknott (Yocto 3.3)
- Builds against a known good and latest HEAD of each release branch

Tekton Observations

I would probably not use Tekton in a production setting

- Doesn't seem to be intended as a full CI/CD solution
- No automatic pipeline run cleanup
  - Workspaces stick around forever, until the run is manually deleted
- No persistent logging
- Has triggers so that builds don't have to be started manually (but I didn't try them)

Future Direction

- Try out other CI systems
  - GitLab
  - Zuul (https://zuul-ci.org/)
  - Jenkins X (https://jenkins-x.io/)
- Write an Operator

Try it for yourself

https://github.com/JPEWdev/kube-battlestar-cluster

- Ansible to maintain K8s cluster and Labgrid coordinator
- YAML files for K8s configuration

Questions?