resin.io

Bringing DevOps to Devices

Modern Update Approaches for Embedded Linux

Petros Angelatos
April 2016

Embedded Linux Conference

About me

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- CTO & Founder of resin.io

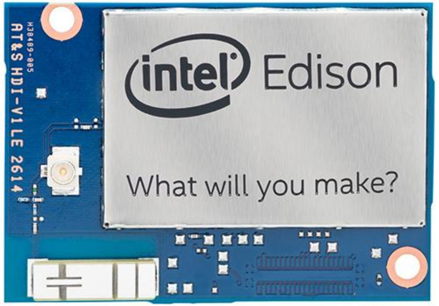
@petrosagg

Agenda

- The need for updates
- Update techniques
- Our solution
  - Device software architecture
  - Yocto architecture
  - Host OS updates
  - Application updates
- Drone demo
- Questions

The need for updates

More powerful devices, more complex software

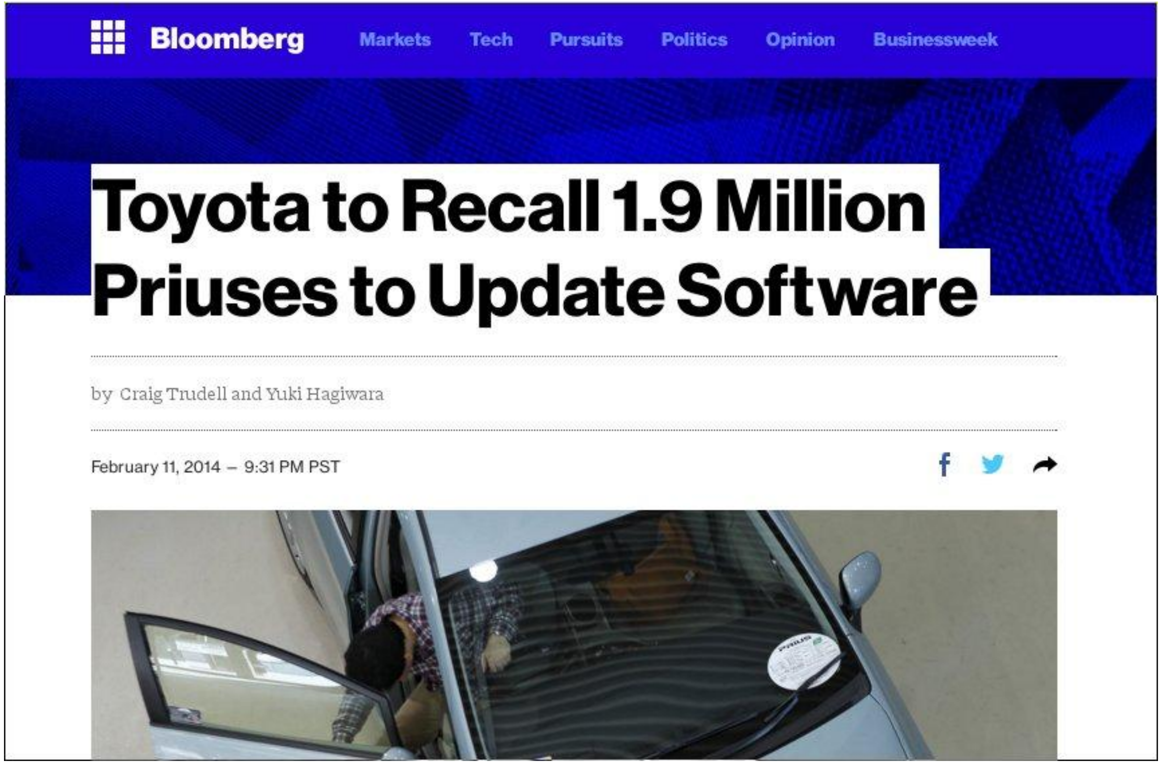


Embedded software now demands the full lifecycle support
we’ve been giving to web, cloud, and mobile.

Importance of updates

- Recalling products costs money
- Higher exposure to security exploits
- Longer release cycles

Importance of updates

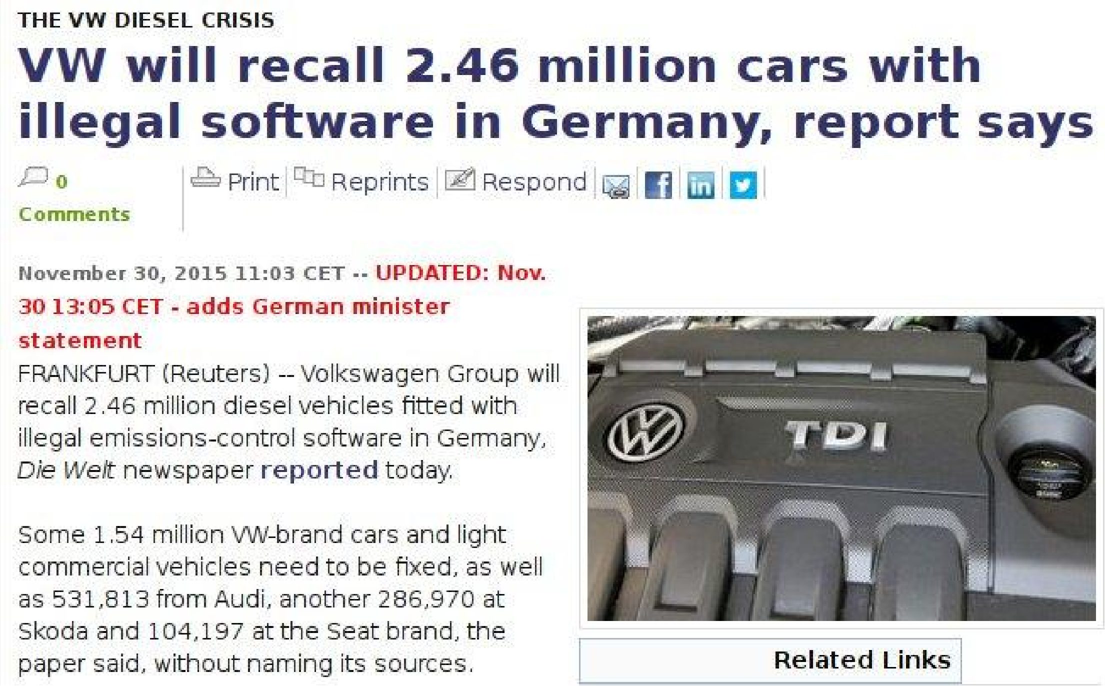


Toyota to Recall 1.9 Million Priuses to Update Software

by Craig Trudell and Yuki Hagiwara

February 11, 2014 – 9:31 PM PST

Importance of updates



THE VW DIESEL CRISIS

VW will recall 2.46 million cars with illegal software in Germany, report says

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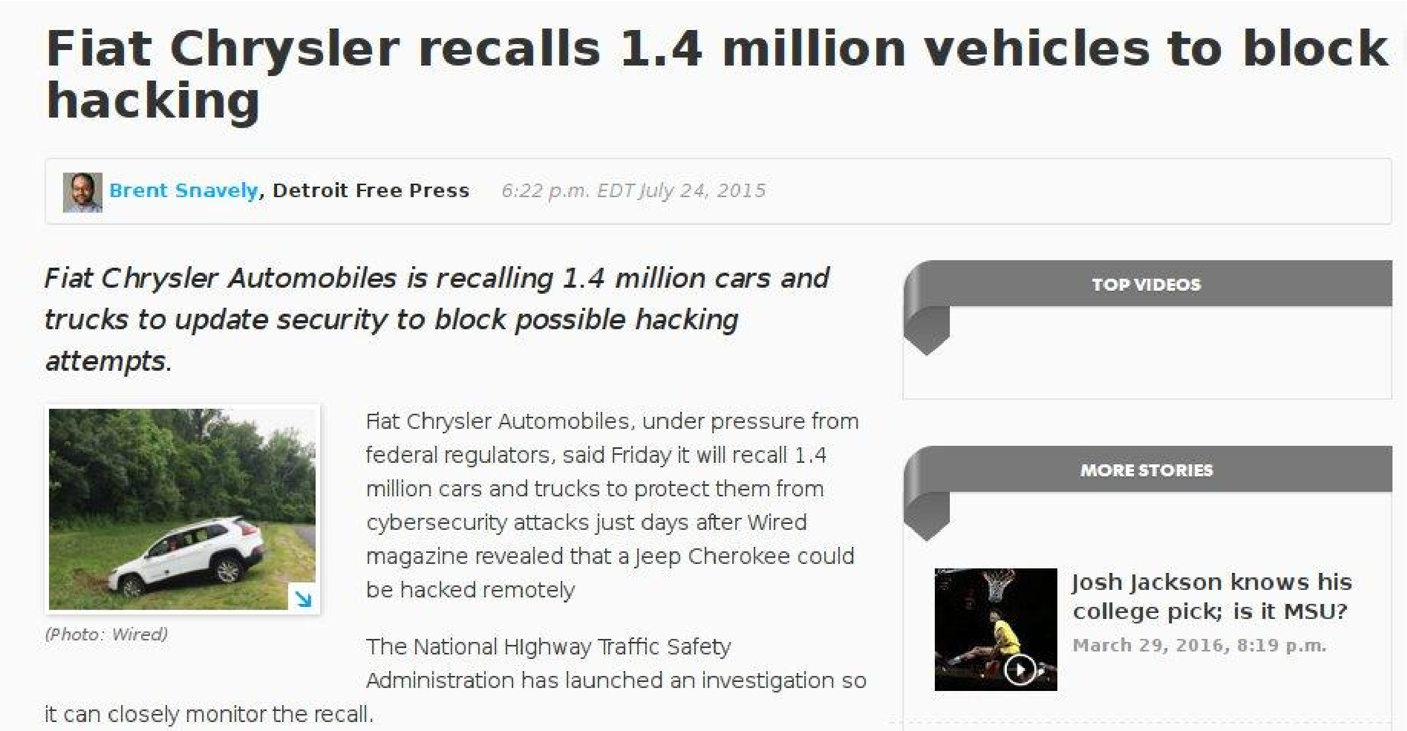
November 30, 2015 11:03 CET -- **UPDATED: Nov. 30 13:05 CET - adds German minister statement**

FRANKFURT (Reuters) -- Volkswagen Group will recall 2.46 million diesel vehicles fitted with illegal emissions-control software in Germany, *Die Welt* newspaper **reported** today.

Some 1.54 million VW-brand cars and light commercial vehicles need to be fixed, as well as 531,813 from Audi, another 286,970 at Skoda and 104,197 at the Seat brand, the paper said, without naming its sources.

Importance of updates



Fiat Chrysler recalls 1.4 million vehicles to block hacking

Brent Snavely, Detroit Free Press 6:22 p.m. EDT July 24, 2015

Fiat Chrysler Automobiles is recalling 1.4 million cars and trucks to update security to block possible hacking attempts.

(Photo: Wired)

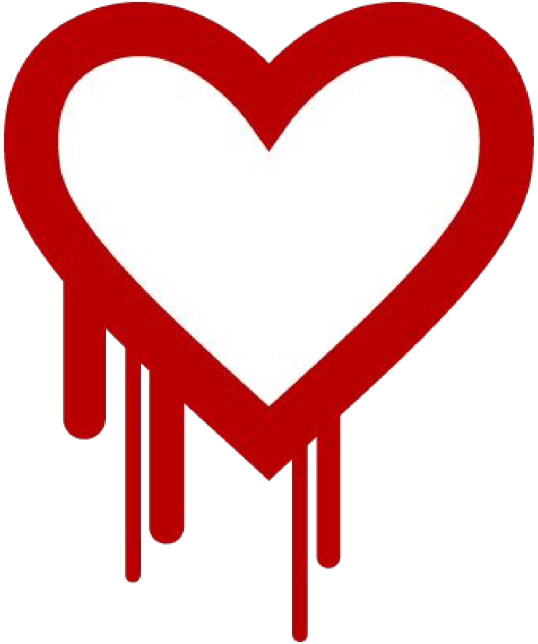
Fiat Chrysler Automobiles, under pressure from federal regulators, said Friday it will recall 1.4 million cars and trucks to protect them from cybersecurity attacks just days after Wired magazine revealed that a Jeep Cherokee could be hacked remotely

The National HIghway Traffic Safety Administration has launched an investigation so it can closely monitor the recall.

Josh Jackson knows his college pick; is it MSU?

March 29, 2016, 8:19 p.m.

Importance of updates



We’ve been there

We’ve been supporting a network with hundreds of screens in 5 countries, for two years.

We’ve had to go out on weekends, in the snow, with drills and USB sticks, upgrading software.

We spent a lot of resources on infrastructure that had little to do with our specific application.

Updates are difficult

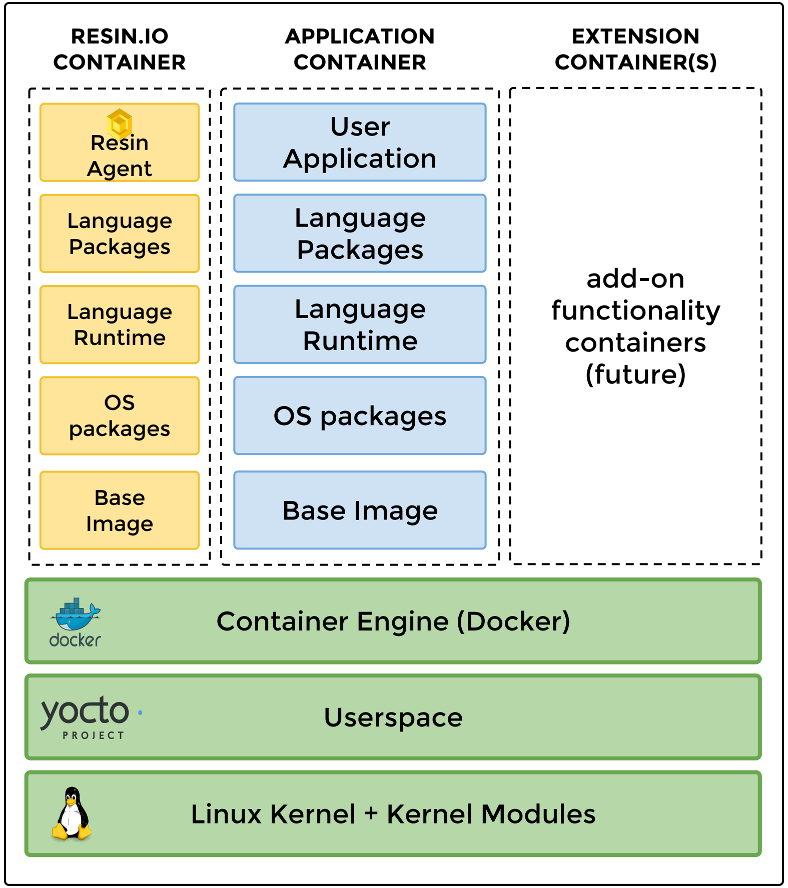
- Poor connectivity
- Intermittent power
- Devices can be anywhere
- Devices could be in the middle of a critical operation
- A failed updated is a bricked device

Various update techniques

- Image based
- Package based
- Containers

Our solution

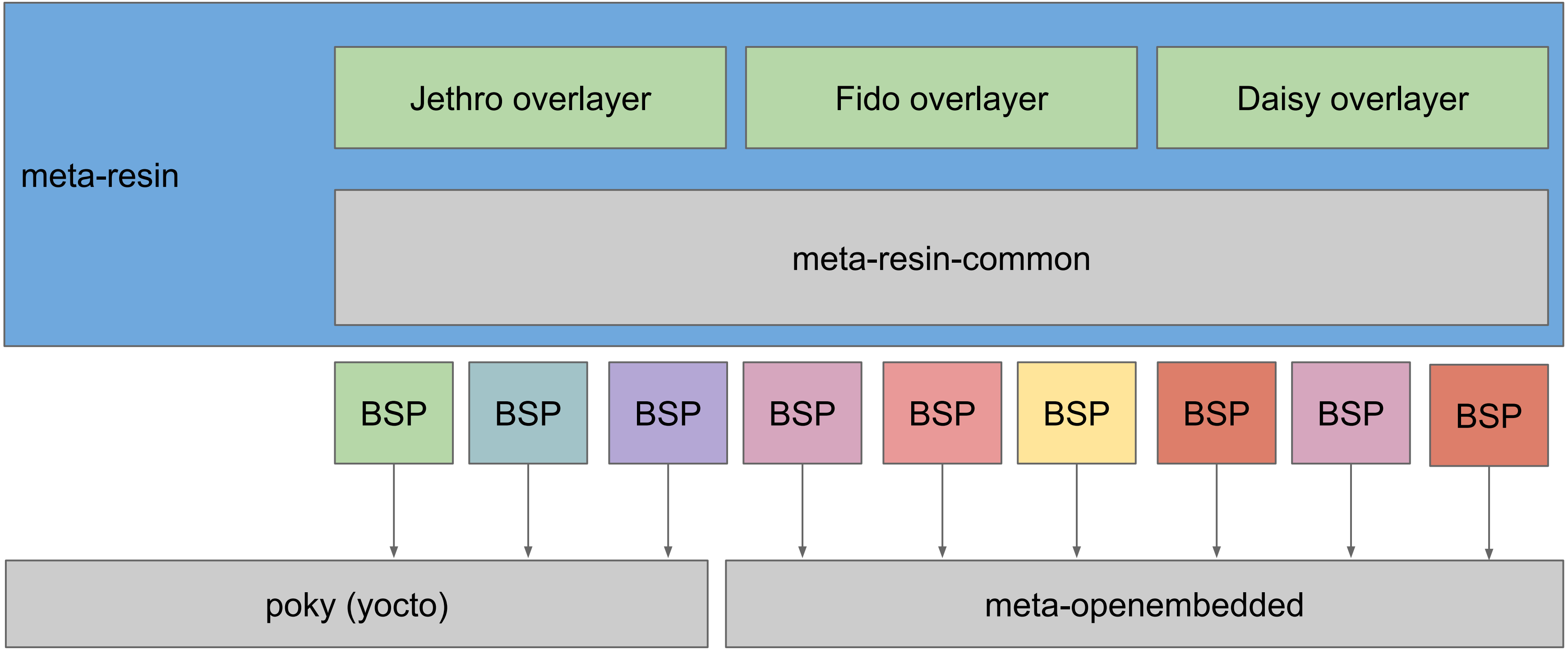
On-device software architecture



The Vision: 100% updateable

- All containers update safely and reversibly. Our own agent (Supervisor) runs in its own container
- Layers shared between containers are stored only once
- Docker and Yocto userspace update using conventional methods
- All software projects we depend on are under open source licenses

Yocto layer architecture



meta-resin

Jethro overlayer

Fido overlayer

Daisy overlayer

meta-resin-common

BSP

BSP

BSP

BSP

BSP

BSP

BSP

BSP

BSP

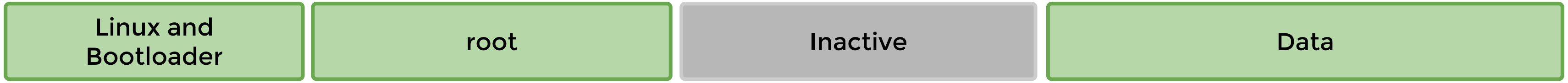
poky (yocto)

meta-openembedded

Host OS updates

- Green/Blue method
- Has been discussed in Yocto mailing list
- Used by
  - CoreOS
  - ChromiumOS
  - Ubuntu Snappy
  - Probably others too

Typical partition layout



Linux and Bootloader

root

Inactive

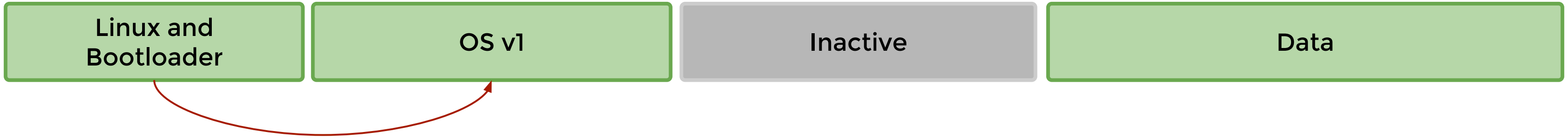
Data

Atomic updates

- Immutable filesystem images

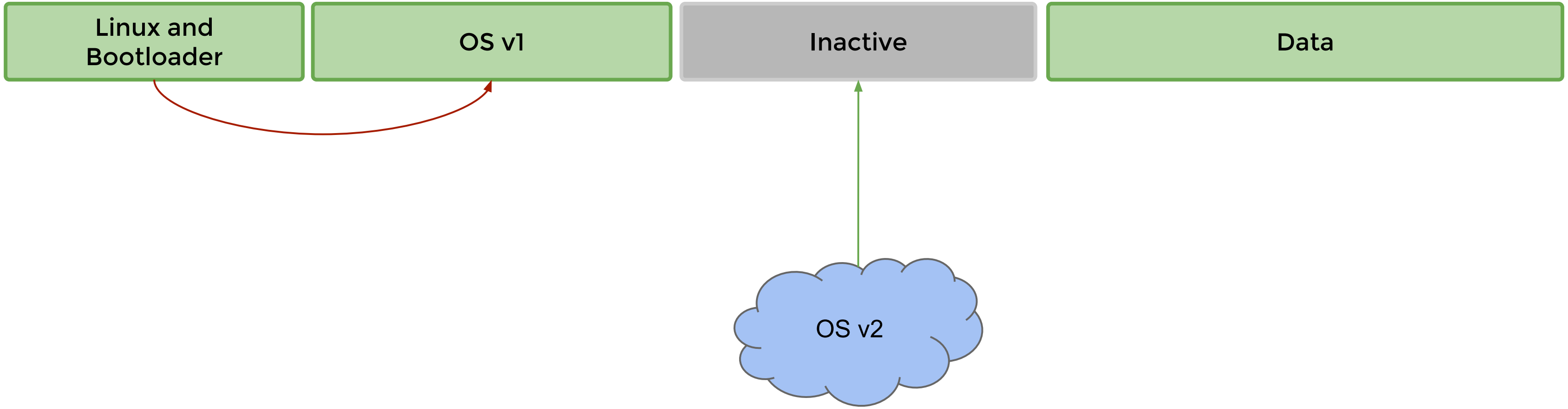
- Image as unit of deployment

Host OS updates



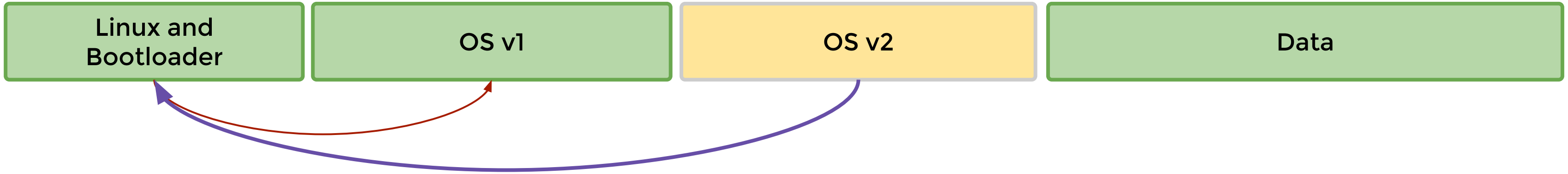
- Initial device state
- Bootloader points to first root partition

Host OS updates



- Version 2 of the OS is downloaded into the inactive partition
- This operation can be interrupted without issues
- At the end, we can verify integrity and sync to disk

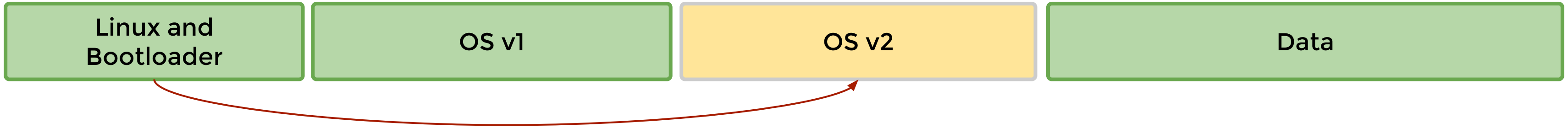
Host OS updates



- Copy bootfiles from the OS image to boot partition
  - Kernel
  - DTBs
  - Initrd
  - etc.

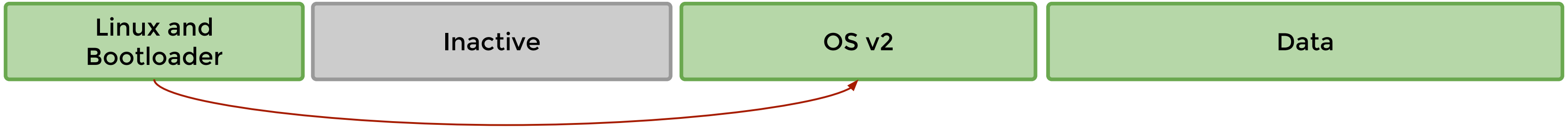
- Do it in a atomic fashion
  - Write tmp file
  - Sync to disk
  - Rename to destination
  - Sync again

Host OS updates



- Flip flag in bootloader to point to the new OS image and to the new OS kernel
- Reboot

Host OS updates



- Final device state after reboot

Failsafe updates

- With the help of hardware watchdogs
- With the help of bootloader logic
- The new version marks itself as stable after running self-test

Container updates

- We use Docker
  - Originally ported Docker to ARM
- No reboot required
  - Move fast, brick nothing

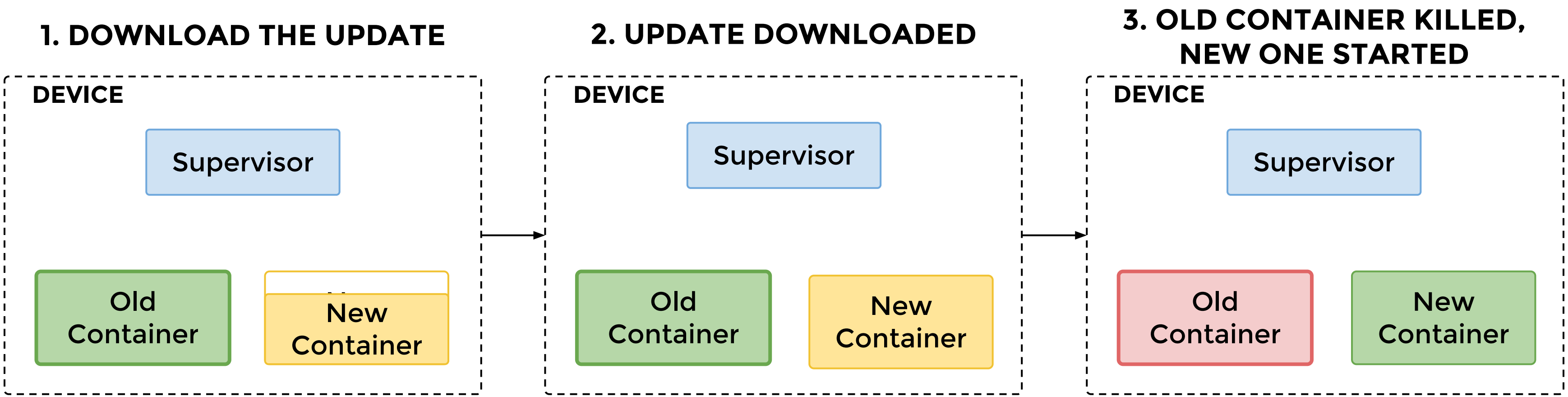
- Efficient in bandwidth through layer sharing
- Efficient in disk IO through layer sharing
  - But we can do better with binary diffs

Container updates

- We can build update strategies depending on requirements
- Can achieve true downtime updates

Update strategies

Strategy 1: Download then Kill (default)



1. DOWNLOAD THE UPDATE

DEVICE

Supervisor

Old Container

New Container

2. UPDATE DOWNLOADED

DEVICE

Supervisor

Old Container

New Container

3. OLD CONTAINER KILLED, NEW ONE STARTED

DEVICE

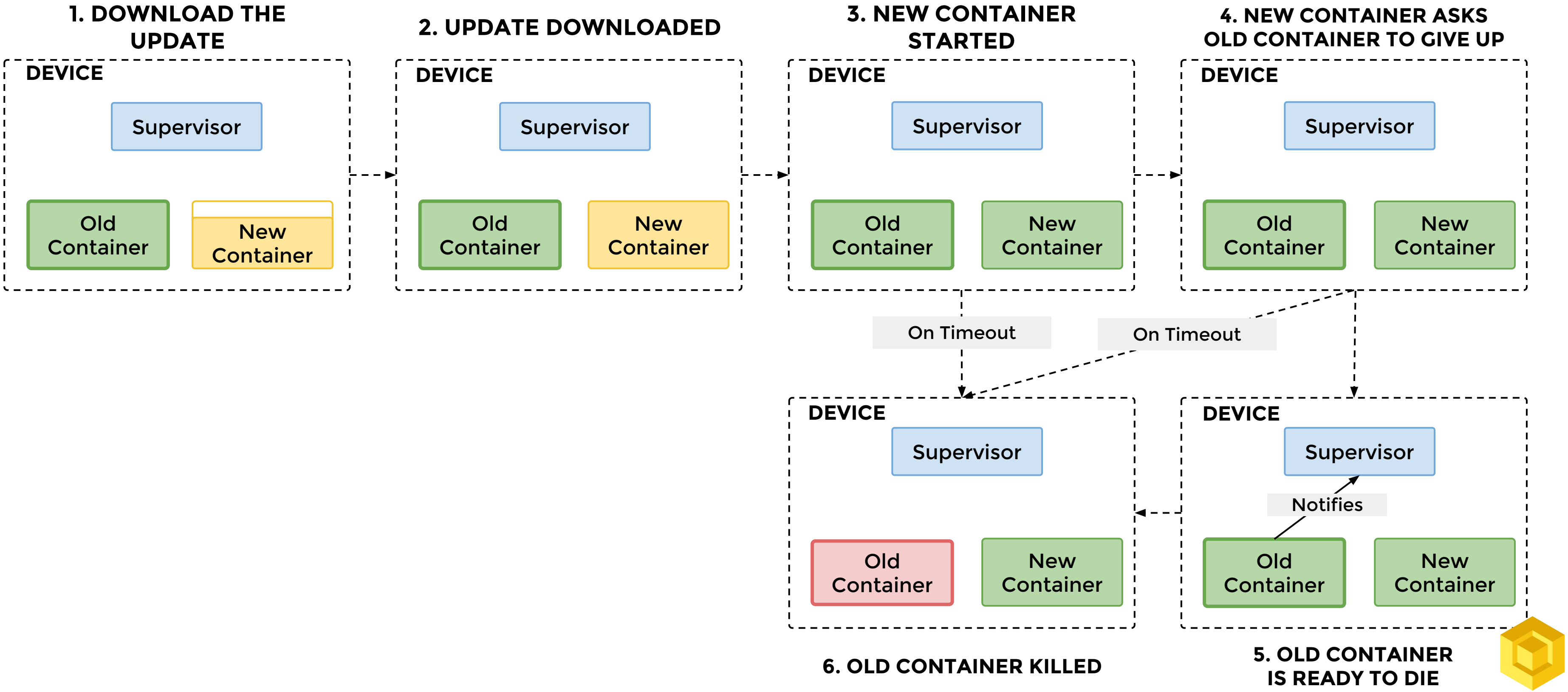
Supervisor

Old Container

New Container

Update strategies

Strategy 2: Hand Over



Drone demo

Food for thought

- If you squint, containers look a lot like host OS images and vice versa

Can we unify?

We think **yes**. Come to our booth to talk about it :)

Open source

- Resin OS Github Organisation
  - https://github.com/resin-os
- Resin device supervisor
  - https://github.com/resin-io/resin-supervisor
- Gitter
  - https://gitter.im/resin-io/chat

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Questions?

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