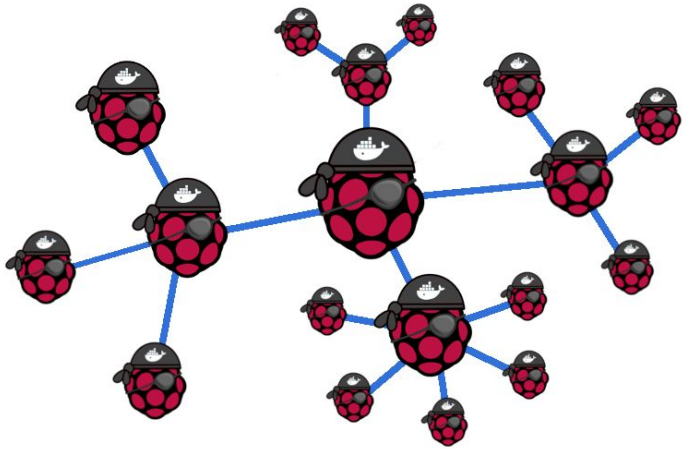
University of Bamberg



Hypriot Cluster Lab

An ARM-Powered Cloud Solution Utilizing Docker

Marcel Großmann
Andreas Eiermann
Mathias Renner

Agenda

1. Challenges induced by IoT/Fog Computing
2. Conceptual Proposal: Single Board Computers & Container Virtualization
3. Proof of Concept: Hypriot Cluster Lab (HCL)

Agenda

1. **Challenges induced by IoT/Fog Computing**
2. Conceptual Proposal: Single Board Computers & Container Virtualization
3. Proof of Concept: Hypriot Cluster Lab (HCL)

Motivation

[Picture: www.offshorewind.biz]

[Picture: www.gruenderfreunde.de]

IoT's Requirements

Hardware

- "Expansion to small"
- High energy efficiency
- Low-cost products

Software

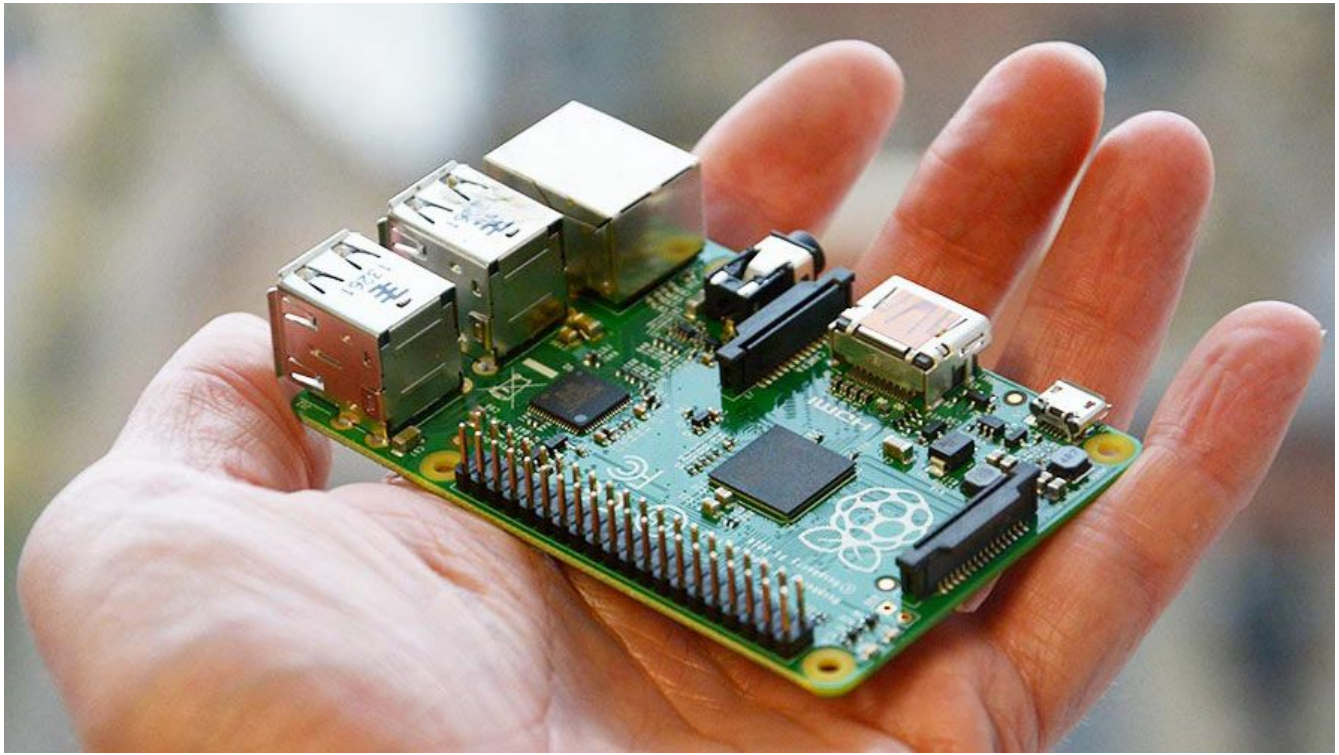
- Standards for Interconnectivity/Interoperability
- Security & Privacy
- Safety
- Scalability
- Manageability
- Automation, Auto-Configuration
- Resilience, Self-Healing
- Open Source

[Renner, 2015]

Agenda

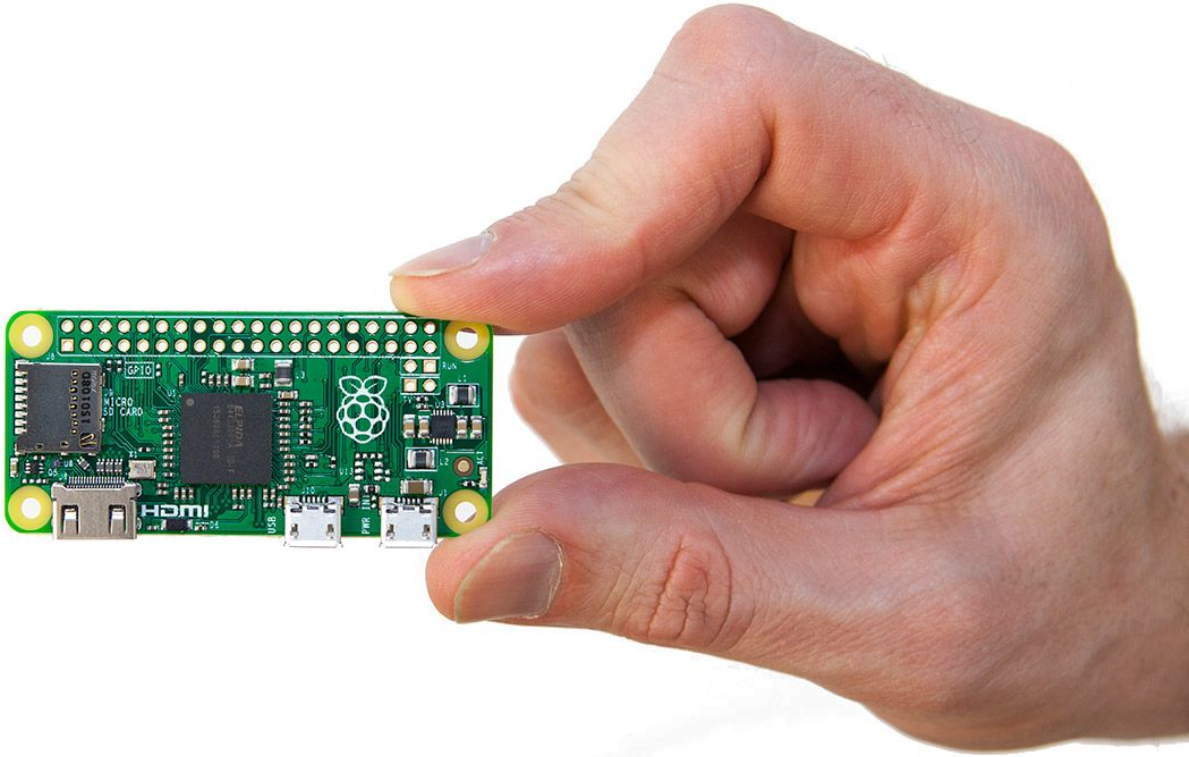
1. Challenges induced by IoT/Fog Computing
2. **Conceptual Proposal: Single Board Computers & Container Virtualization**
3. Proof of Concept: Hypriot Cluster Lab (HCL)

IoT Hardware Model: Raspberry Pi 3



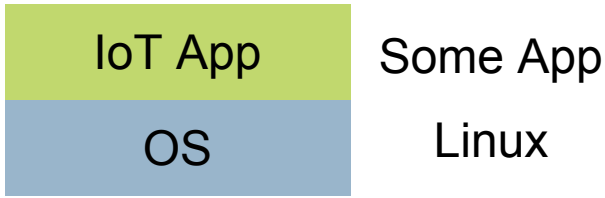
[Picture: www.alphr.com]

Raspberry Pi Zero

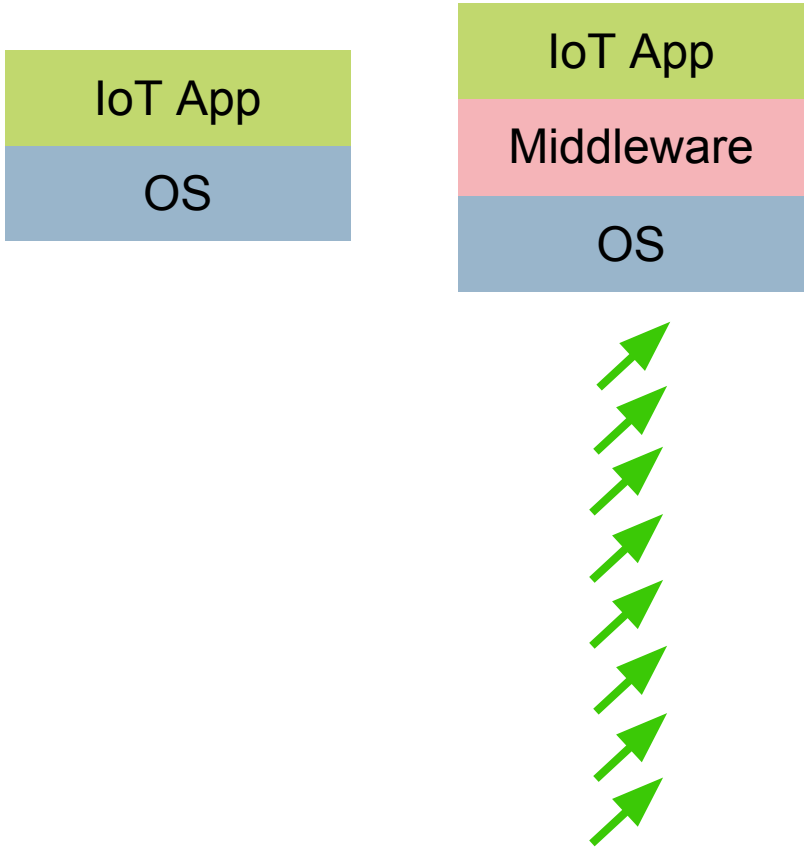


[Picture: raspberrypi-spy.co.uk]

IoT Software Stack

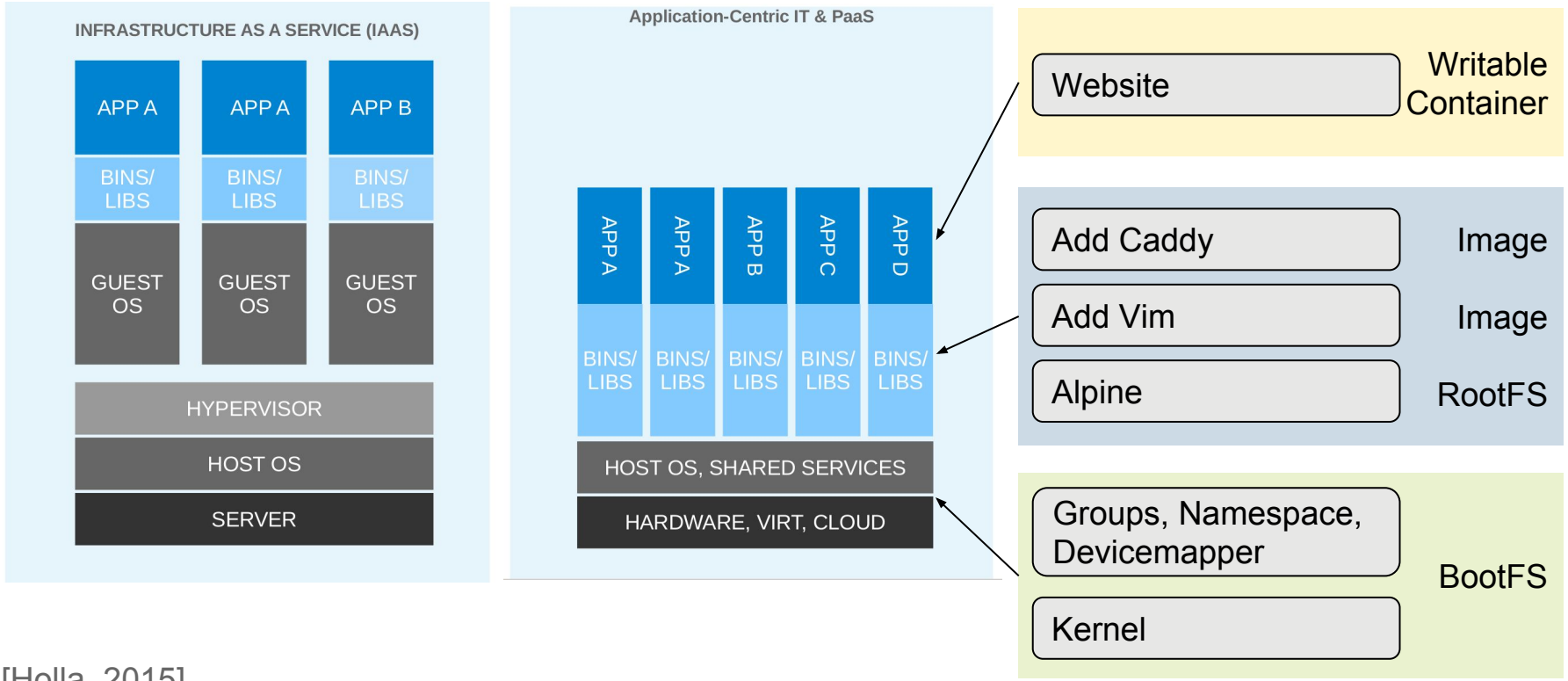


Does Container Virtualization meet IoT's requirements?



- Standards for Interconnectivity/Interoperability
- Security & Privacy
- Safety
- Scalability
- Manageability
- Automation, Auto-Configuration
- Resilience, Self-Healing
- Open Source

Evolution of Virtualization



[Holla, 2015]

VM vs. Container Virtualization

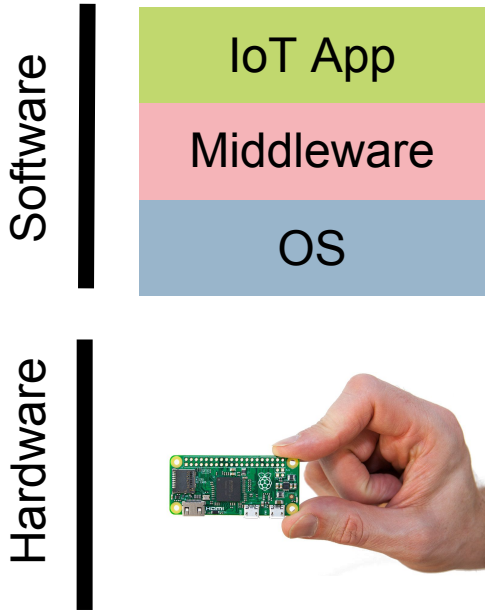
Hypervisor	Container-Enabled Kernel
Runs Operating System	Runs processes
Heavyweight isolated virtual machines	Lightweight kernel namespaces
Can theoretically emulate any architecture	Is less flexible in architecture emulation
VMs start via a full boot-up process	Very fast namespace + process creation
Platform-oriented solution	Service-oriented solution
Optimized for generality	Optimized for minimalism and speed

Wifi for First Live Demo: Starting Webserver

SSID: hcl@ict
Password: hcl4iotrocks

Then go to: http://hcl.ict

Summary



Agenda

1. Challenges induced by IoT/Fog Computing
2. Conceptual Proposal: Single Board Computers & Container Virtualization
3. **Proof of Concept: Hypriot Cluster Lab (HCL)**

Proof of concept: Hypriot Cluster Lab

- A piece of software, built against IoT's requirements
- Status: Proof of concept, not production ready
- Available on *Github.com*
- Cooperation between University of Bamberg and the Hypriot Team
- Includes lots of plumbing: Docker, Avahi, Dnsmasq...

HCL vs. IoT's requirements

Hardware

- High energy efficiency
- "Expansion to small"
- Low-cost products

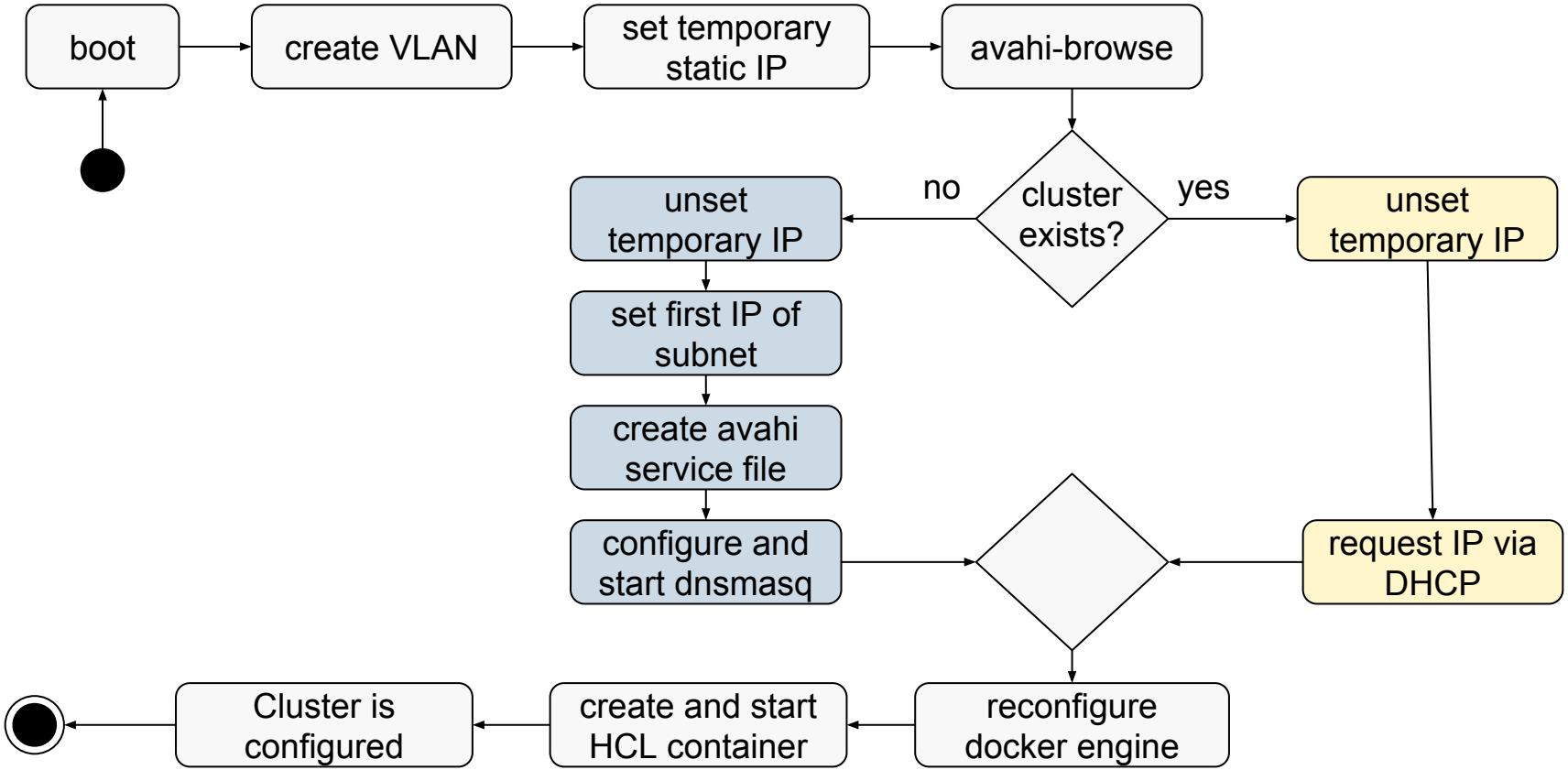
Software

- Standards for Interconnectivity/Interoperability
- Security & Privacy
- Safety
- Scalability
- Manageability
- Resilience, Self-Healing
- Open Source

HCL: Outlook

- Add feature: Resilience by integrating Kubernetes/Mesos/Nomad
- Add security layer with TINC

HCL Setup Process

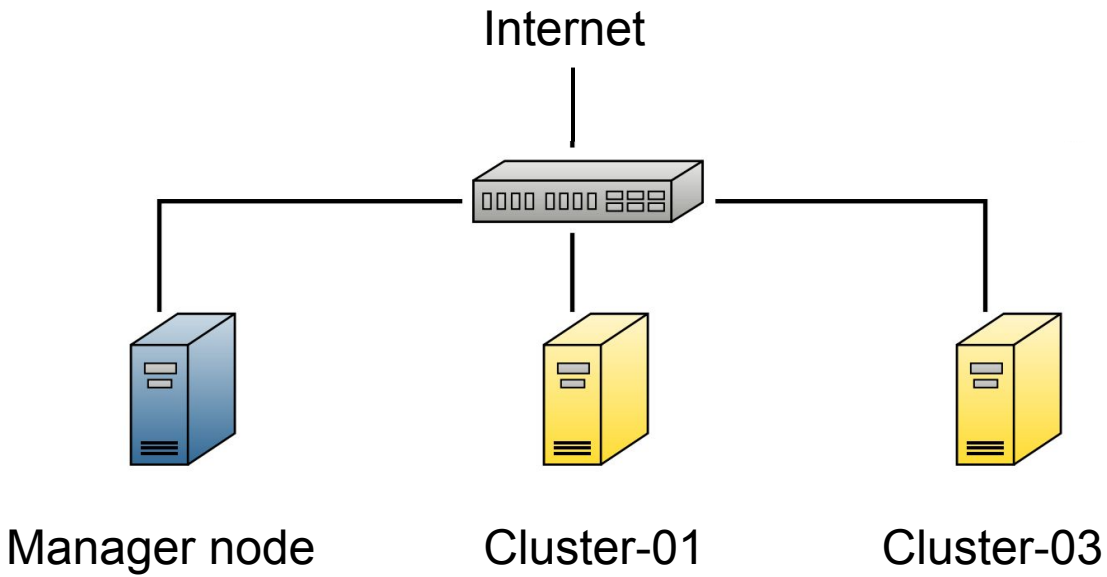


Use Cases

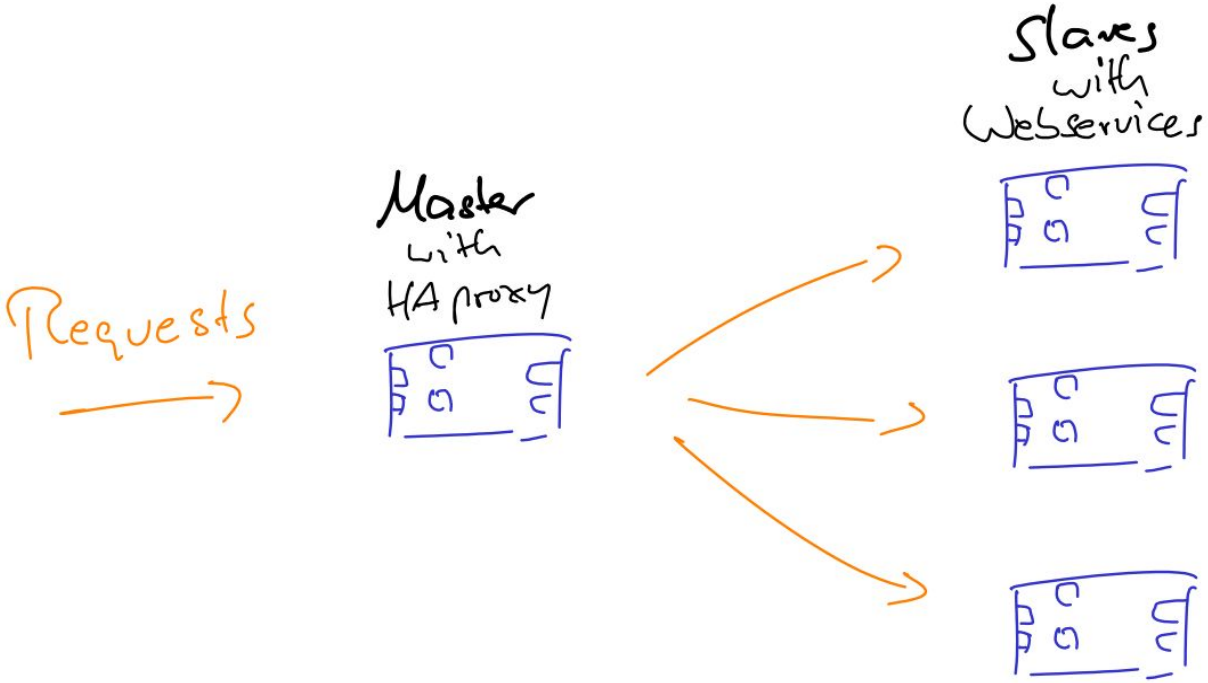
[Picture: www.offshorewind.biz]

[Picture: www.gruenderfreunde.de]

Use Case 1: Communication via Overlay Network

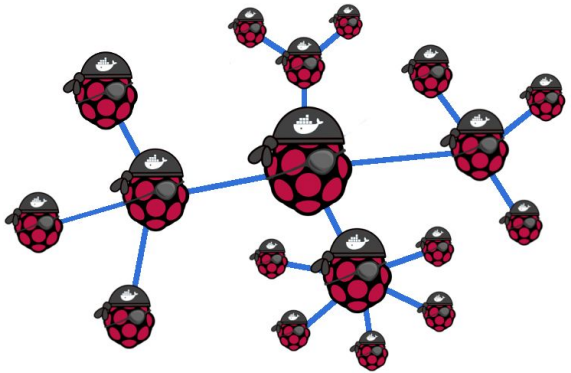


Use Case 2: Loadbalancing



Literature

- Renner, M. (2015). *Evaluation of Container Technology as a Model for the Infrastructure of the Internet of Things.* http://mathias-renner.de/thesis.pdf
- Holla, S. (2015). *Orchestrating Docker : manage and deploy Docker services to containerize applications efficiently*. Birmingham: Packt Publishing.



University of Bamberg

Questions ?

Marcel Großmann
marcel.grossmann@uni-bamberg.de
Andreas Eiermann
andreas@hypriot.com
Mathias Renner
mathias@hypriot.com