Hypriot Cluster Lab

An ARM-Powered Cloud Solution Utilizing Docker

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Agenda

1. Challenges induced by IoT/Fog Computing
3. Proof of Concept: Hypriot Cluster Lab (HCL)
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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
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IoT Hardware Model: Raspberry Pi 3
Raspberry Pi Zero

[Picture: raspberrypi-spy.co.uk]
IoT Software Stack

- IoT App
- OS
- Linux

Some App

- IoT App
- Middleware
- OS
- Linux

Some App

- Container Virtualization
Does Container Virtualization meet IoT’s requirements?

- Standards for Interconnectivity/Interoperability
- Security & Privacy
- Safety
- Scalability
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Evolution of Virtualization

[Holla, 2015]
# VM vs. Container Virtualization

<table>
<thead>
<tr>
<th><strong>Hypervisor</strong></th>
<th><strong>Container-Enabled Kernel</strong></th>
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<tbody>
<tr>
<td>Runs Operating System</td>
<td>Runs processes</td>
</tr>
<tr>
<td>Heavyweight isolated virtual machines</td>
<td>Lightweight kernel namespaces</td>
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<tr>
<td>Can theoretically emulate any architecture</td>
<td>Is less flexible in architecture emulation</td>
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<tr>
<td>VMs start via a full boot-up process</td>
<td>Very fast namespace + process creation</td>
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<tr>
<td>Platform-oriented solution</td>
<td>Service-oriented solution</td>
</tr>
<tr>
<td>Optimized for generality</td>
<td>Optimized for minimalism and speed</td>
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Wifi for First Live Demo: Starting Webserver

SSID: hcl@ict
Password: hcl4iotrocks

Then go to: http://hcl.ict
Summary

Middleware

OS

IoT App

Software

Hardware
Agenda

1. Challenges induced by IoT/Fog Computing
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

1. **boot** → create VLAN → set temporary static IP → avahi-browse
   - avahi-browse does not find a cluster?
     - unset temporary IP
     - set first IP of subnet
     - create avahi service file
     - configure and start dnsmasq
     - request IP via DHCP
     - reconfigure docker engine
   - Cluster is configured

   - Cluster is configured
     - create and start HCL container
     - reconfigure docker engine

   - Cluster is configured
Use Cases

[Picture: www.offshorewind.biz]

[Picture: www.gruenderfreunde.de]
Use Case 1: Communication via Overlay Network

Manager node   Cluster-01   Cluster-03
Use Case 2: Loadbalancing
Literature

Questions?

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