Automated Testing for Embedded development

Next generation Board Farming

Chris Fiege – cfi@pengutronix.de
About Pengutronix

### Most active 5.14 employers

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About Me

Chris Fiege
Senior Hardware Developer

✉️ cfi@pengutronix.de
🐦 SmithChart
族自治州
Why talk about Board Farming?

More at elinux.org:
- https://elinux.org/Board_Farm#Software
Why talk about Board Farming?

https://baylibre.com/baylibre-lava-box/

https://www.youtube.com/watch?v=Hx9MEhR05cU

(Add your custom solution here.)

https://3mdeb.com/shop/
Topics

- What is Board Farming and why you may want to do it?
- How Pengutronix does it
- Pros and Cons for the current approach
- Next generation Board Farm

- Discussion
Controlling an Embedded Linux Device?
Board farming?

- Automated control of devices
- Working from remote and board sharing
- Run tests
- Continuous testing

Board farming is an important foundation for quality assurance for all software on real hardware.
Pengutronix: Use cases

Interactive

- Work on a software component on real hardware.
- Run or develop a test suite.

Automated

- Testsuite executed by CI without human interaction.
Pengutronix Board Farm: Hardware
Pengutronix Board Farm: Hardware

- 16x or 24x Power Switch
- 24x Ethernet
- RS232 Serial Server
Pengutronix Board Farm: Hardware

- Test-Server
  - USB Host
    - 1-Wire via USB
    - GPIO
  - CAN
  - 20x USB
  - USB Host
    - 20x USB
Pengutronix Board Farm: Hardware

- Wifi-AP
- Bluetooth Beacon
Pengutronix Board Farm: Hardware

- 8 racks with 128 slots (total) in our regular lab
- 10+ labs with 4 .. 16 slots each on desks
Pengutronix Board Farm: Continuous Testing

https://jenkins.io

https://about.gitlab.com

https://docs.pytest.org/
Labgrid

- Documentation:

- „About the joy and tears of testing Embedded Devices“
  https://fosdem.org/2021/schedule/event/testing_embedded_devices/
What works well?

Single hardware pool for interactive and CI/CT
⊕ Only a single board is needed
⊕ Easier debugging of failing tests
⊕ Every developer can access every board in the lab
What works well?

Single hardware pool for interactive and CI/CT

⊕ Only one set of hardware is needed
⊕ Easier debugging of failing tests
⊕ Every developer can access every board in the lab
⊕ Provisioning of DUT from scratch => deterministic results
What works well?

Labs are built to be versatile

⊕ Every hardware can be placed in every lab
Problems

Devices are connected with many cables

- Chance of accidental disconnection when working on an adjacent device
- Moving a device into another lab is error prone
Problems

Infrastructure devices are a black box

- e.g. serial-server missing characters
- e.g. power switches not providing IPv6
- e.g. power switches not responding
Expensive Problems

USB
Expensive Problems

USB

⊕ easy to use, widely available
Expensive Problems

CAN JTAG Logic analyser

RS232

USB-SD-Mux

USB-Mux

UART

USB EVERYWHERE...
Expensive Problems

USB is a bad idea

⊕ easy to use, widely available
⊕ stability issues
⊕ consumer USB devices have bugs
⊕ hard to debug
Expensive Problems

**USB is a bad idea**

⊕ easy to use, widely available
⊕ stability issues
⊕ consumer USB devices have bugs
⊕ hard to debug
⊕ often needs „remote hands“ to recover
⊕ problems often affect neighbouring slots
⊕ costs time/money and nerves!
Potential Solution: Less Black Boxes

- 16x or 24x Power Switch
- 24x Ethernet
- RS232 Serial Server
- Test-Server
  - USB Host
  - 1-Wire via USB
  - GPIO
  - CAN
  - 20x USB
- WiFi-AP
- Bluetooth Beacon
Potential Solution: Smaller USB Bus-Size

- 16x or 24x Power Switch
- 24x Ethernet
- RS232 Serial Server
- Test-Server
  - USB Host
    - 1-Wire via USB
    - GPIO
    - CAN
    - 20x USB
  - USB Host
    - 20x USB
- Wifi-AP
- Bluetooth Beacon
Potential Solution: Less Cables

- 16x or 24x Power Switch
- 24x Ethernet
- RS232 Serial Server
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Test Automation Controller

**Concept:**

- Cover 80% of the use cases in everyday use
- More robust than current setup
- Built for everyday use
Test Automation Controller

ARM SoC
+ Linux
+ labgrid
+ IOBus
Test Automation Controller

Infrastructure side

Ethernet PoE Switch

Ethernet PoE In

ARM SoC
  + Linux
  + labgrid
  + IOBus

DUT
Test Automation Controller

Infrastructure side
- Ethernet PoE In
- Switch

DUT side
- Ethernet Out
- GPIO
- UART
- CAN
- IOBus
- Switch
- USB
- DUT

ARM SoC
+ Linux
+ labgrid
+ IOBus
Test Automation Controller

Current state:
- Hardware: V1
- Software: In active development

Next step:
- Concept validation

New problems:
- FIXME
Thank you!

Questions and Discussion!