Booting It Successfully
For The First Time In Mainline

Embedded Linux Conference

March 12 - 14, 2018
Hilton Portland
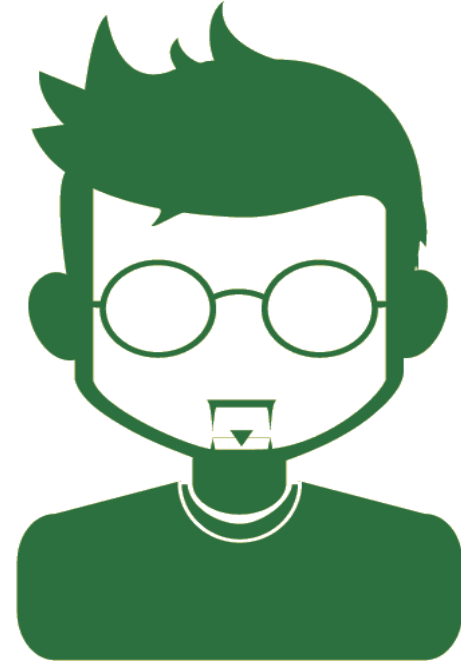Portland, OR
#lfelc #openiot

Open First

Enric Balletbò i Serra
Electronics Engineer

- Hardware and Linux enthusiast
- Kernel contributor
- More than 10 years of experience bringing-up different kind of boards

COLLABORA

Enric Balletbò i Serra
Electronic Engineer

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- Kernel contributor
- More than 10 years of experience engineering different kind of boards.
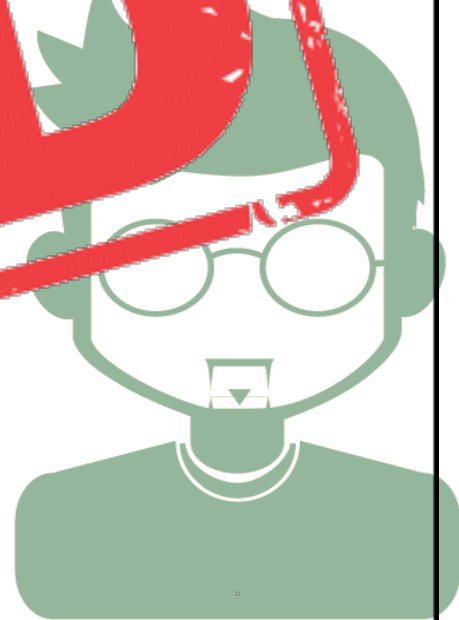
FIRED

Agenda

- **What is Board Bring-Up?**
- **Bring-Up process of a new board**
- **What's the problem**
- **How software can help us with ...**
- **Conclusions**
- **Lessons learned**

What is Board Bring-Up?

> *Board bring-up is the process of validating, both electrically and functionally, a new circuit board design including the porting of boot firmware and the development of a Board Support Package.*

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Bring-Up process of a new board

Hardware

- **Component selection**
- Circuit Design (Schematic)
- Bill of Materials (BOM)
- PCB prototypes
- Assembly verification
- Basic hardware test

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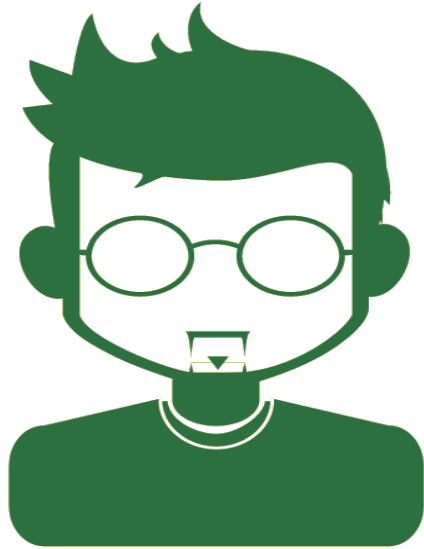**Hardware**

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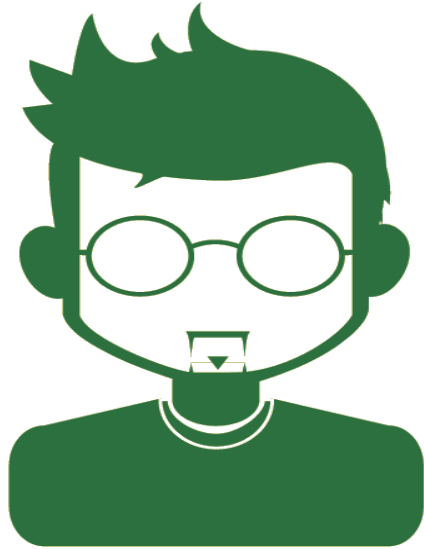# Bring-Up process of a new board

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Bring-Up process of a new board

Software

- **Firmware programming**
- Boot-loader
- Kernel and device drivers
- Software stack
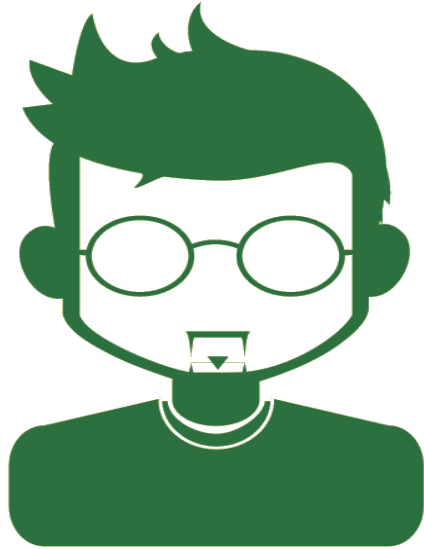- Application development

Bring-Up process of a new board

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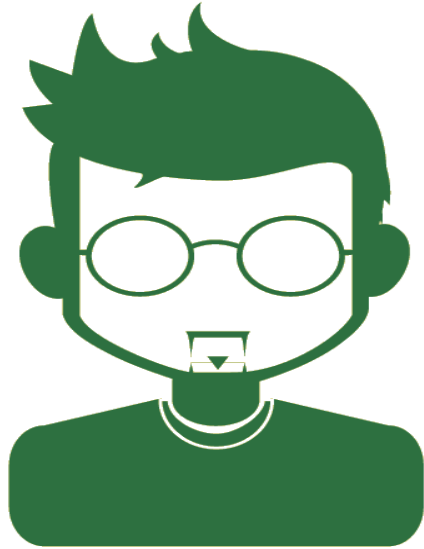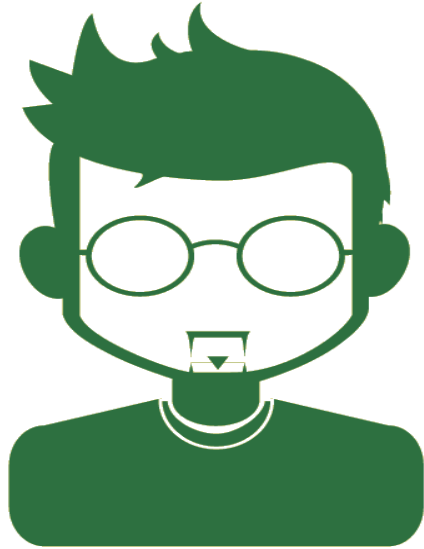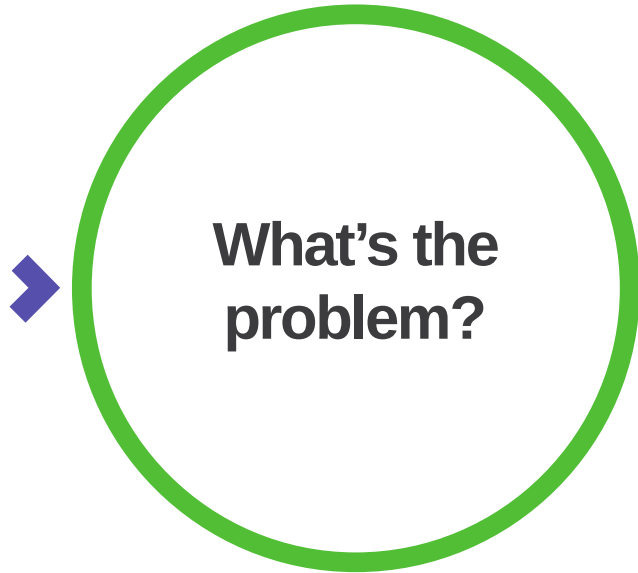- Application development

Bring-Up process of a new board

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- **Kernel and device drivers**
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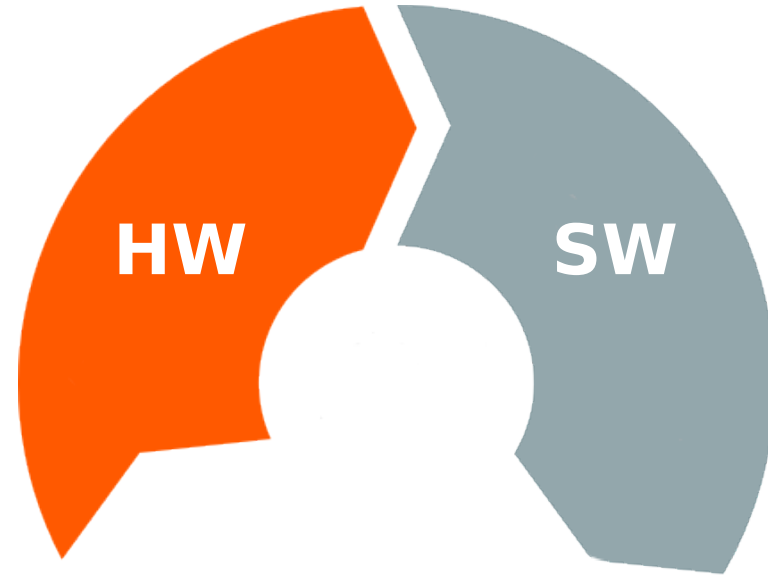
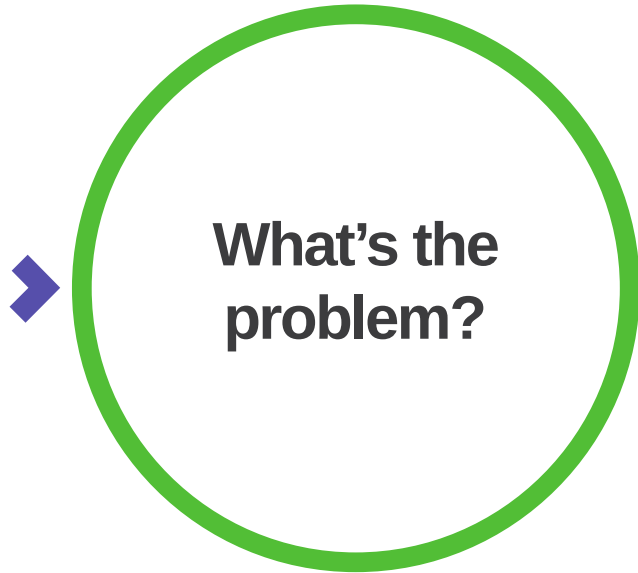# Bring-Up process of a new board

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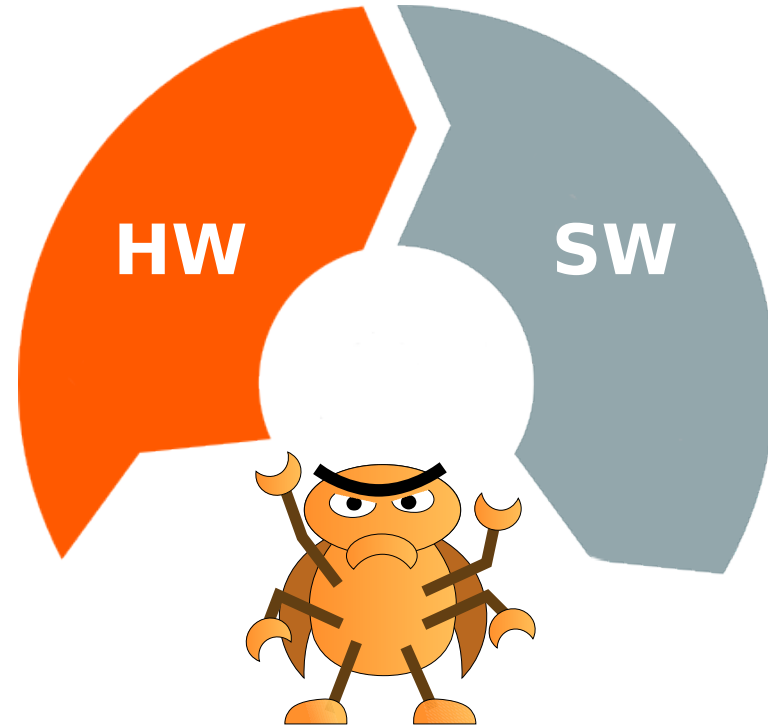- Software stack
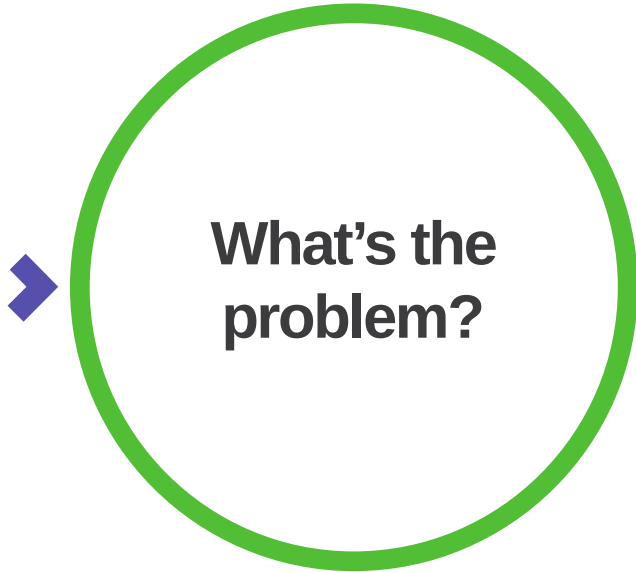- **Application development**

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What's the problem?

HW

What's the problem?

HW

SW

What's the problem?

HW

SW

What's the problem?

HW SW

What's the problem?

And how we can solve this?

Software

Hardware

COLLABORA
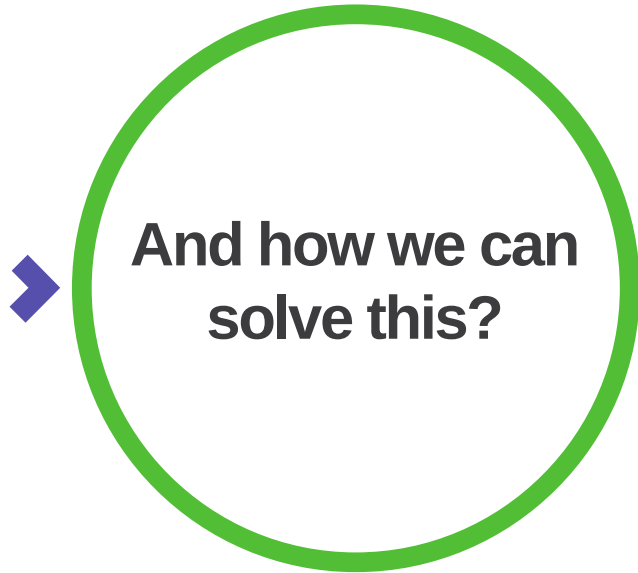
Work together from the beginning!
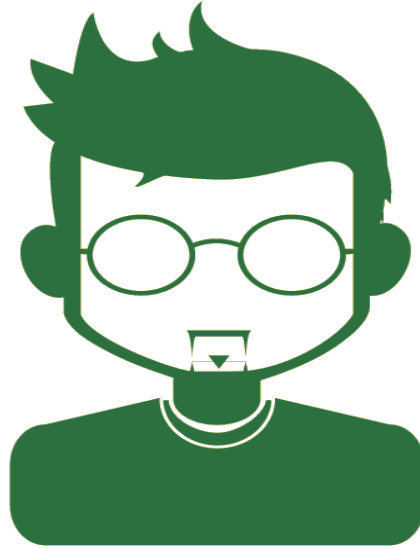
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Software

Hardware

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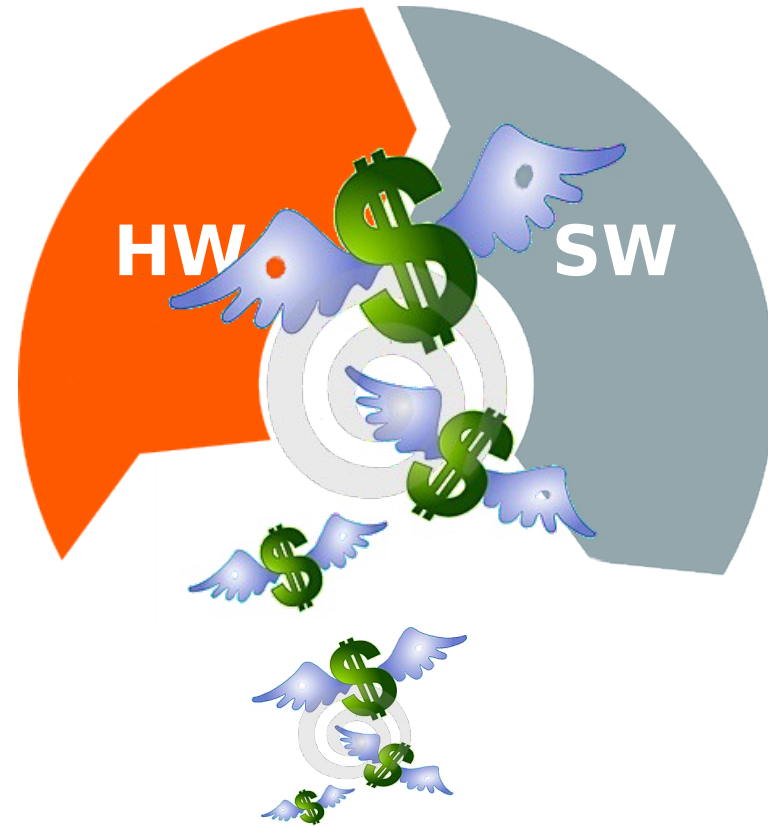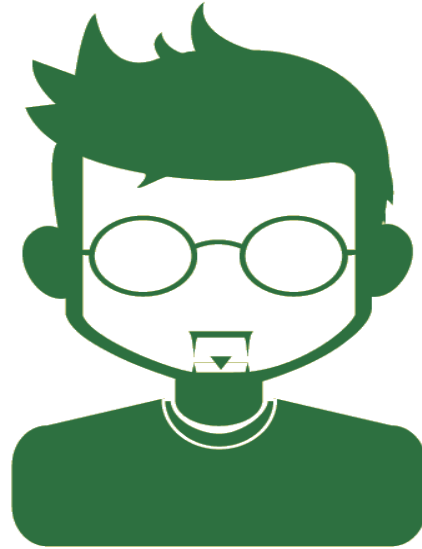- **How software can help us with ...**
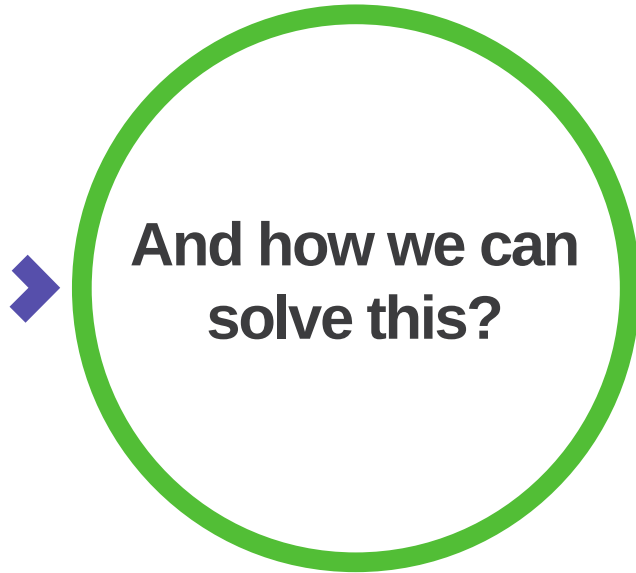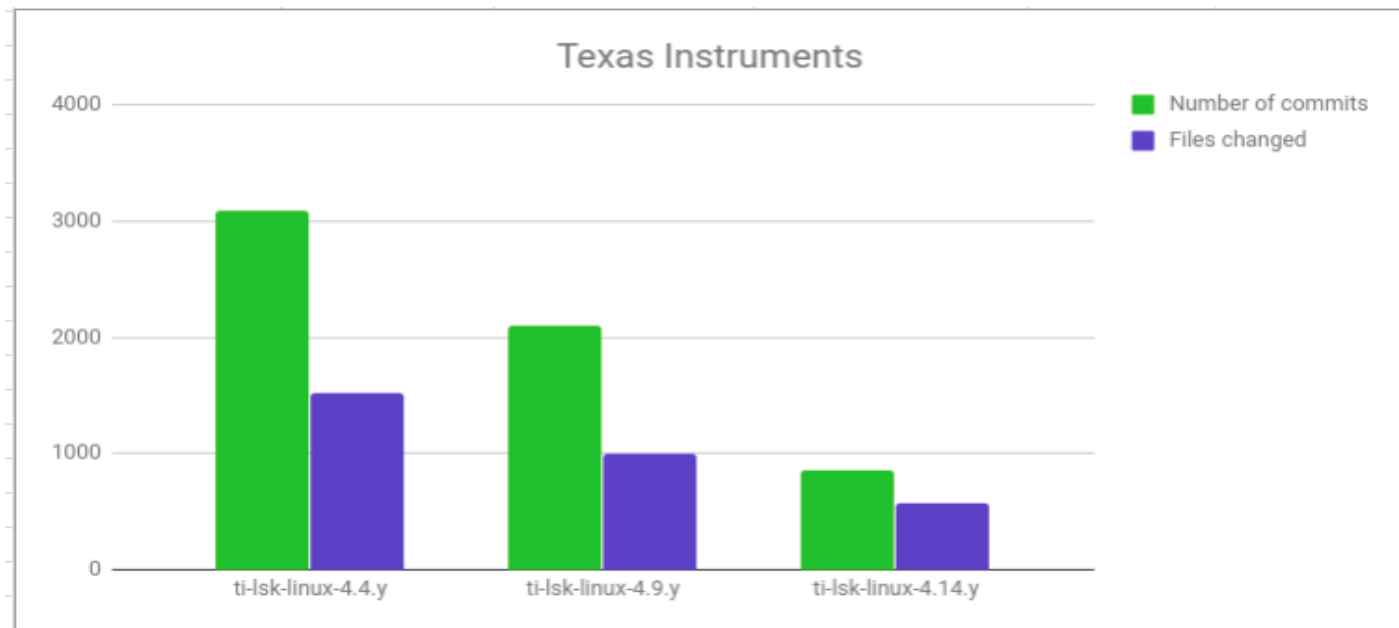- **Conclusions**
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How software can help us with:
Component Selection

- *Main processor*
  - Evaluate the Board Support Package
  - Evaluate mainline support
- *Other IC* (sensors, displays controller, real time clocks, etc)
  - Check that the driver is upstream
- *Extra note*
  - Do NOT overuse microcontrollers

Vendor vs Mainline

Texas Instruments

| Vendor branch	Stable version	Number of commits	Files changed	Insertions	Deletions
ti-lsk-linux-4.4.y	4.4.113	3084	1526	192339	28440
ti-lsk-linux-4.9.y	4.9.83	2103	995	119505	16509
ti-lsk-linux-4.14.y	4.14.24	860	576	60541	4555

How software can help us with:
Circuit Design (Schematic)

- Let software team review the schematic
  - Write the device tree file
  - Special attention with:
    - Muxer settings (power management)
    - Enable of ICs and regulators
    - Lines crossed (TX/RX, MISO/MOSI, etc)
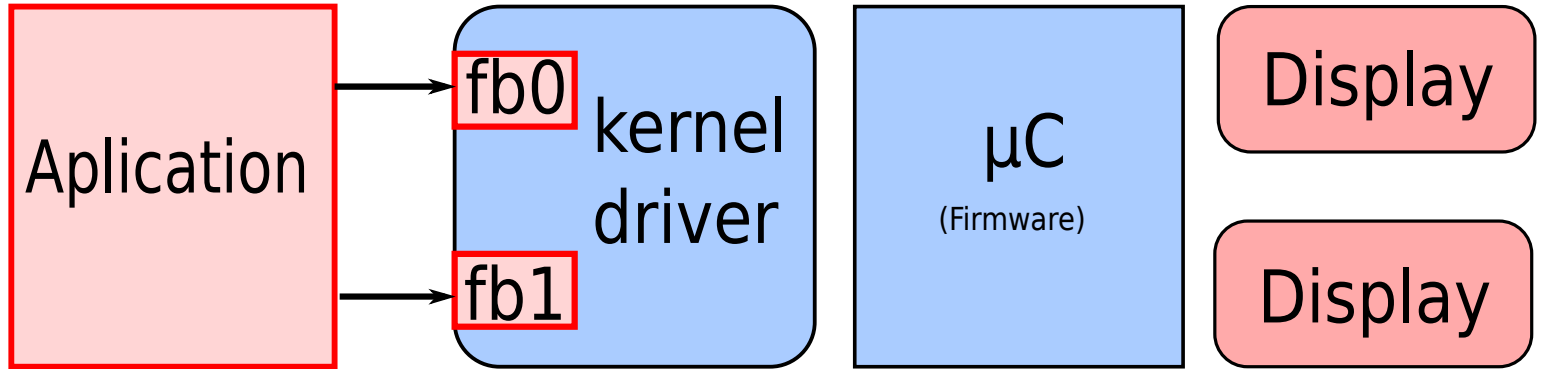   - I2C addresses

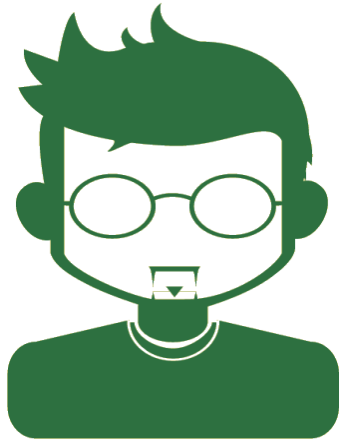# Connecting two displays (First option)

Hardware

Connecting two displays (First option)

Aplication → fb0 / fb1 → kernel driver → µC (Firmware) → Display / Display
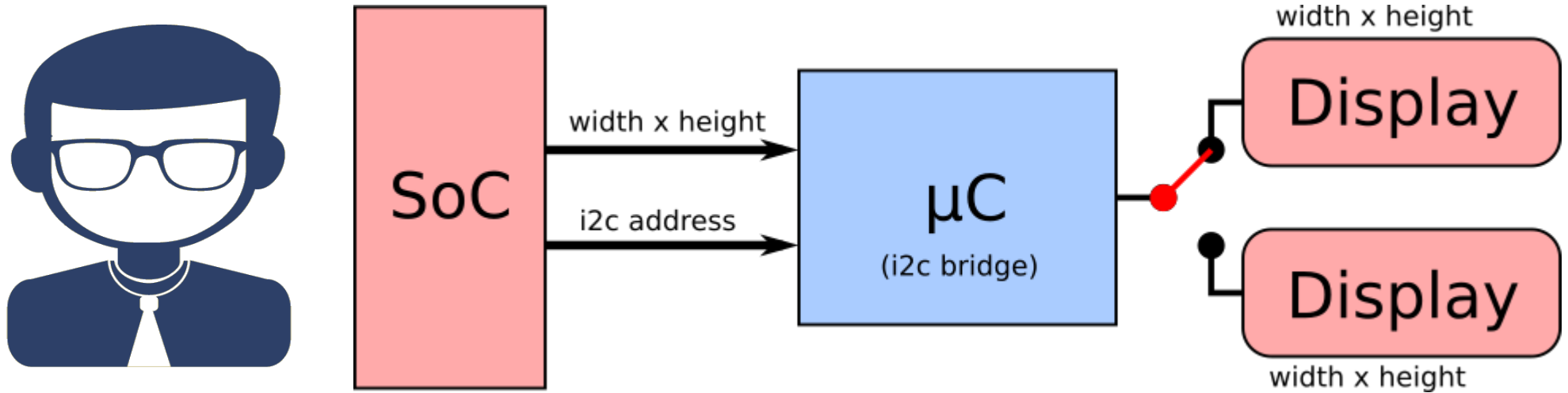
Software

Connecting two displays (Second option)

Hardware

Connecting two displays (Second option)

Application → fb0 | kernel driver | FPGA (Bitstream) | Display | Display
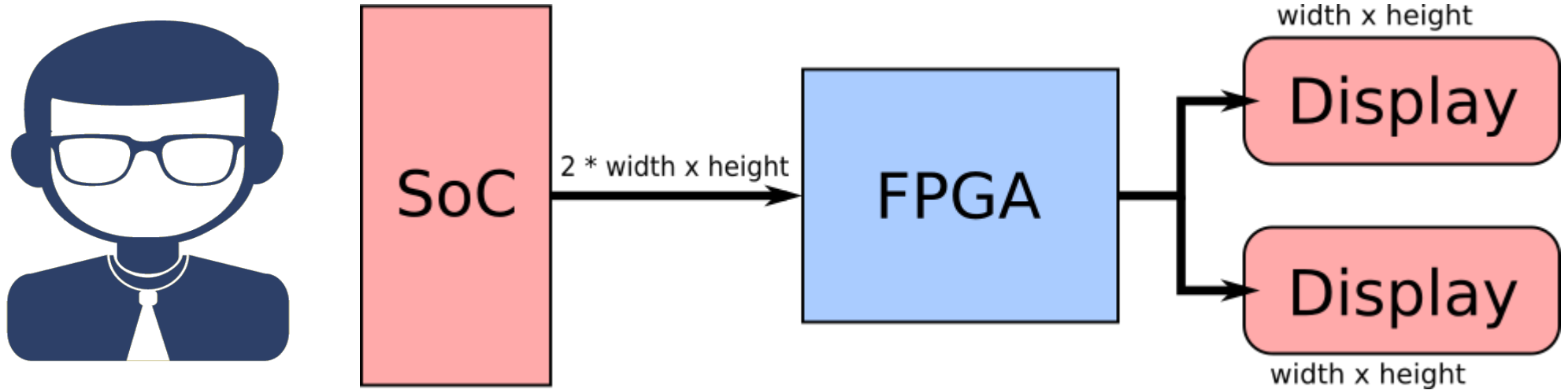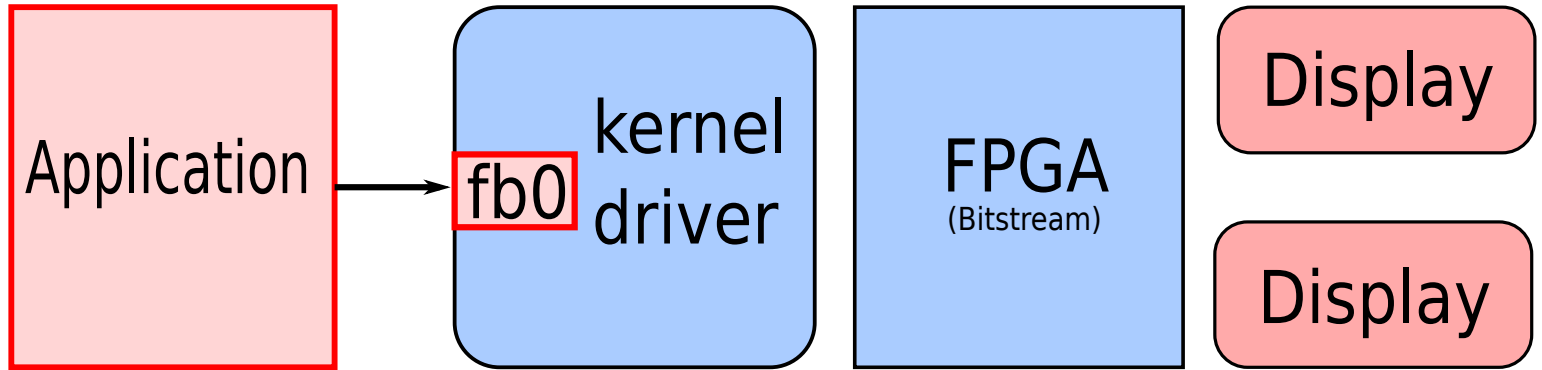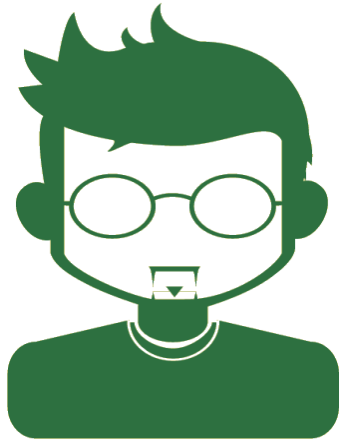
Software

How software can help us with:
Bill Of Materials (BOM)

- An alternative part might have different software support

How software can help us with:
PCB Prototypes

- Time to plan your tests?
  - Stress testing
  - Performance testing
  - Connectivity testing
  - Functional testing
- Manual testing or automated testing

How software can help us with:
Assembly Verification

- Run stress and throughput tests
  - RAM memory
  - Non-volatile memory
  - Buses (USB, SPI, I2C, etc)
- Define a test case for all that is wired

How software can help us with:
Basic Hardware Test

- Functional testing
  - Against the business requirements of application
- User Acceptance testing
  - Verify that a solution works for the user
- Regression testing
  - Every time you do a hardware modification

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Booting it successfully for the first time with mainline

- **NO SECRET**
  - Your hardware must be supported in mainline
  - Component selection matters

- **Upstream first**
  - Upstream it before you get the first prototypes

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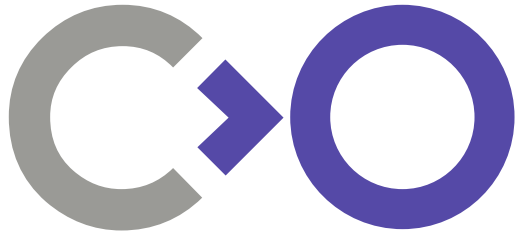- **Conclusions**
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Lessons learned

- Review the schematic from software point of view can catch lots of errors

- Try to develop the software as much as possible even before you have the first prototypes

- Before doing a respin, test for regressions

COLLABORA

Thank you!