



# Nuttx in space

a pocketQube satellite application

PRESENTED BY:

**Fabio Balzano**

Lead Engineer at Stara corp.





# Today's Topics

- Overview of our platform
- Why Nuttx?
- Nuttx duties
- Challenges
- Our building system





# Our platform



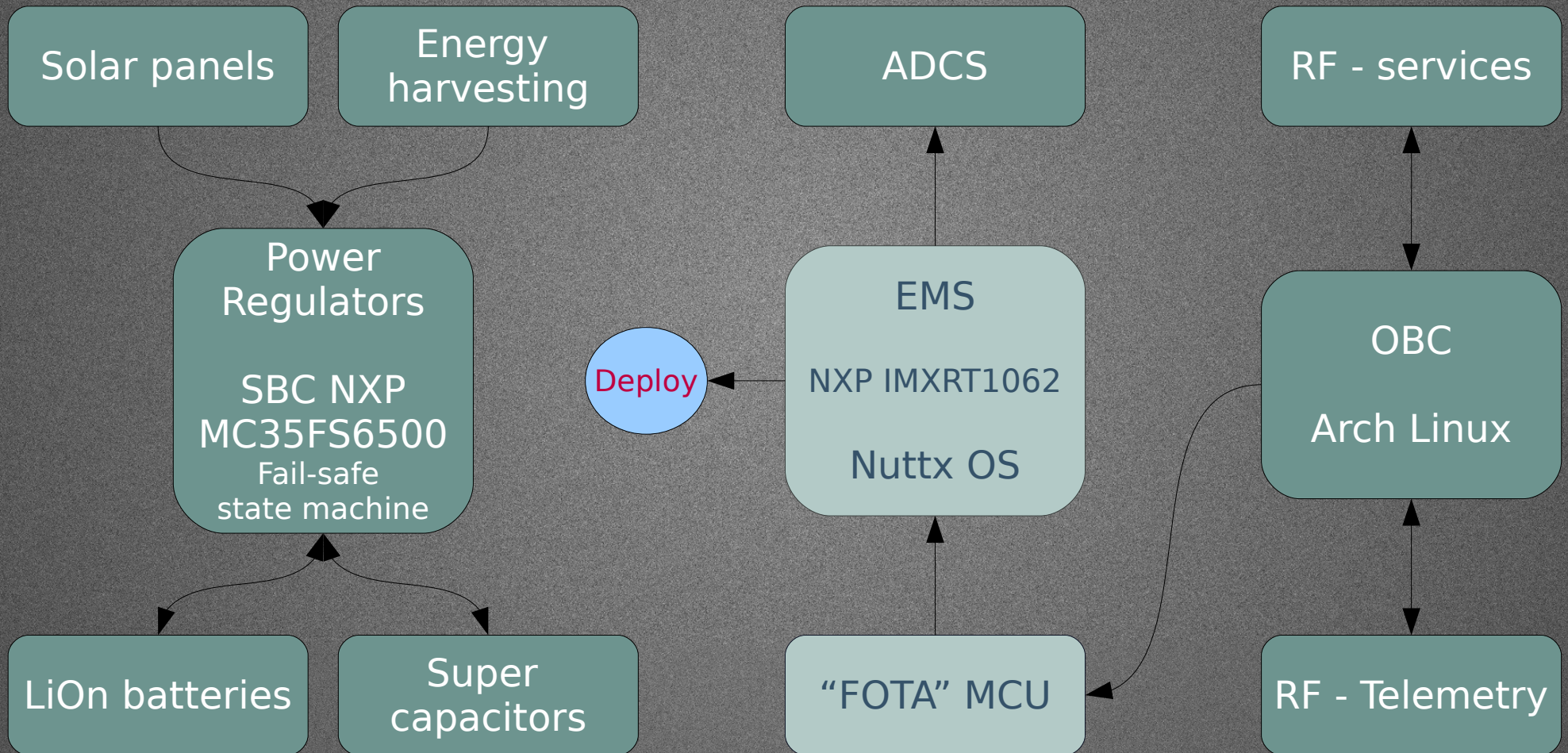


# Overview

- PocketQube standard form factor
- “Heterogeneous” system
- Automotive standards for electronic circuits
- Innovative
- Cheapest as possible
- Easy to assembly and efficient to test

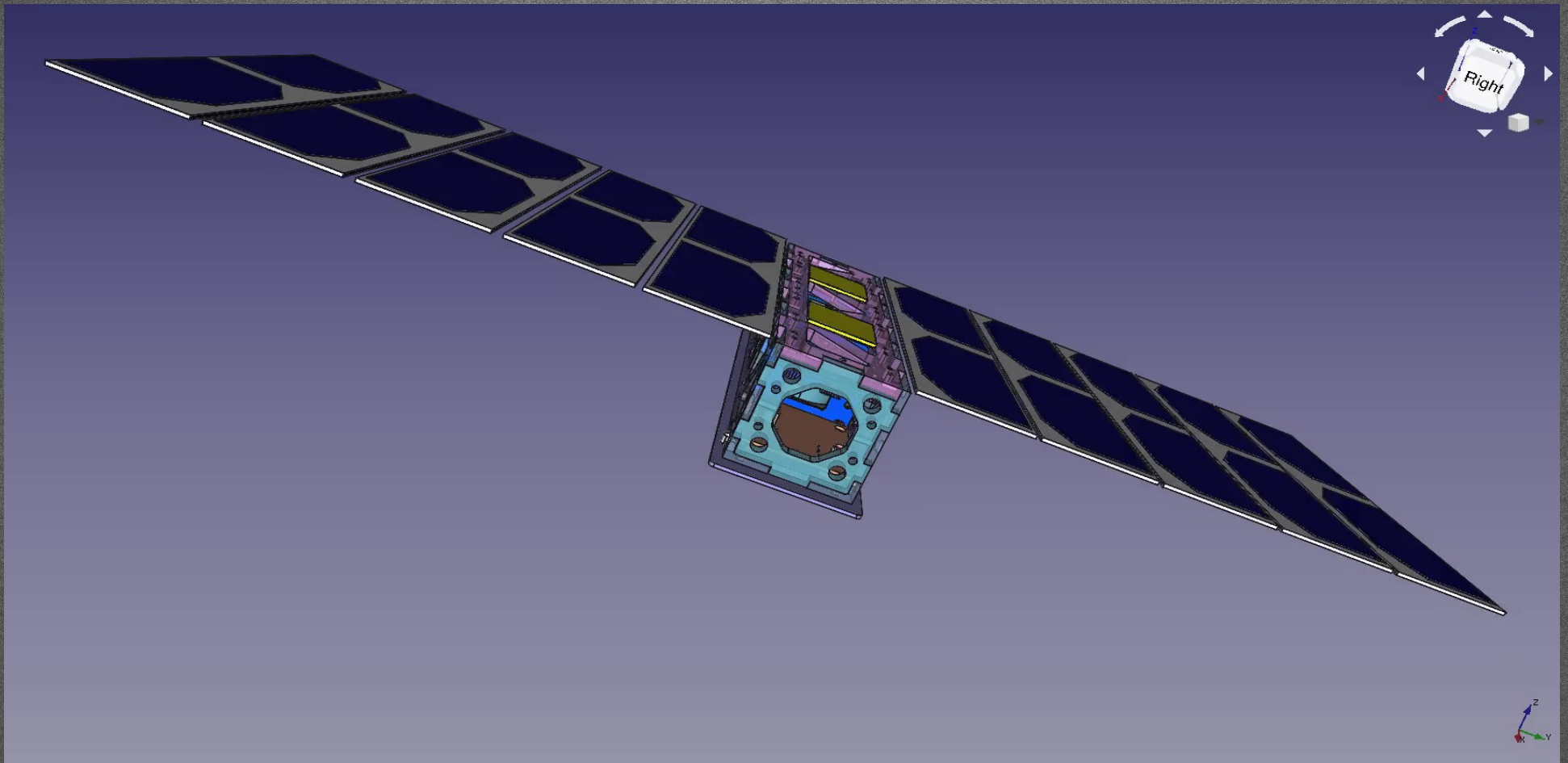


# Overview



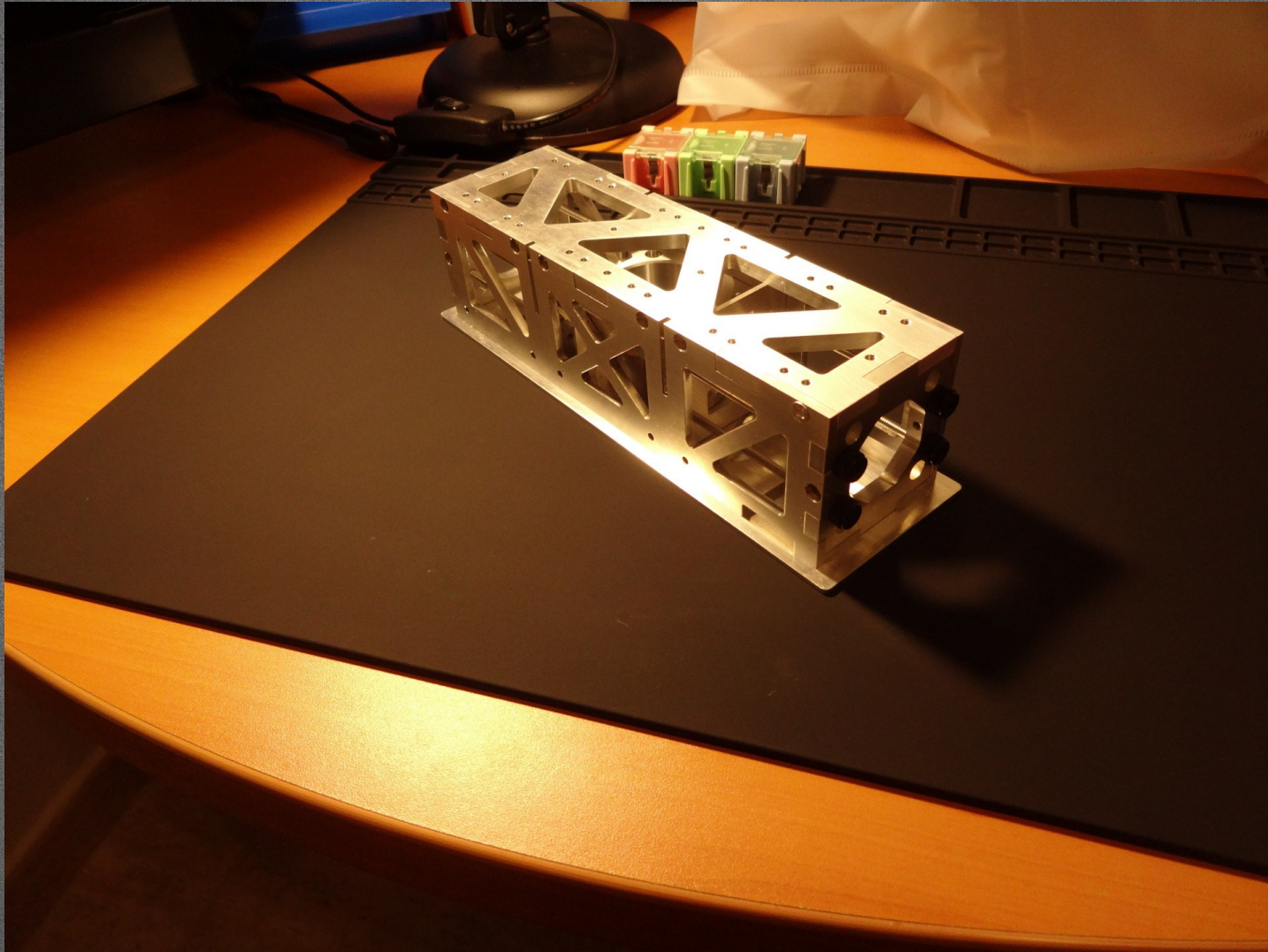


# 3D model



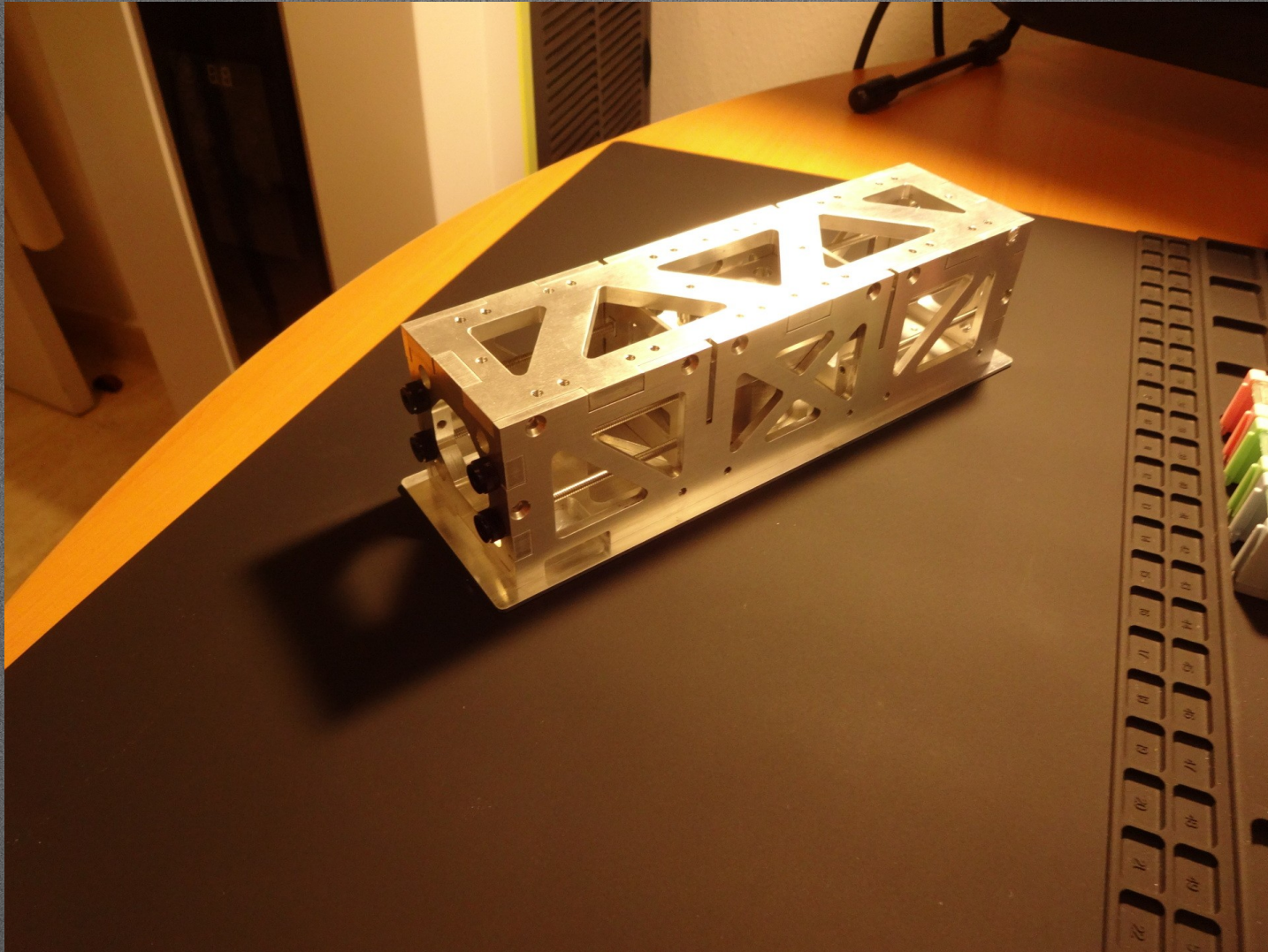


# Details



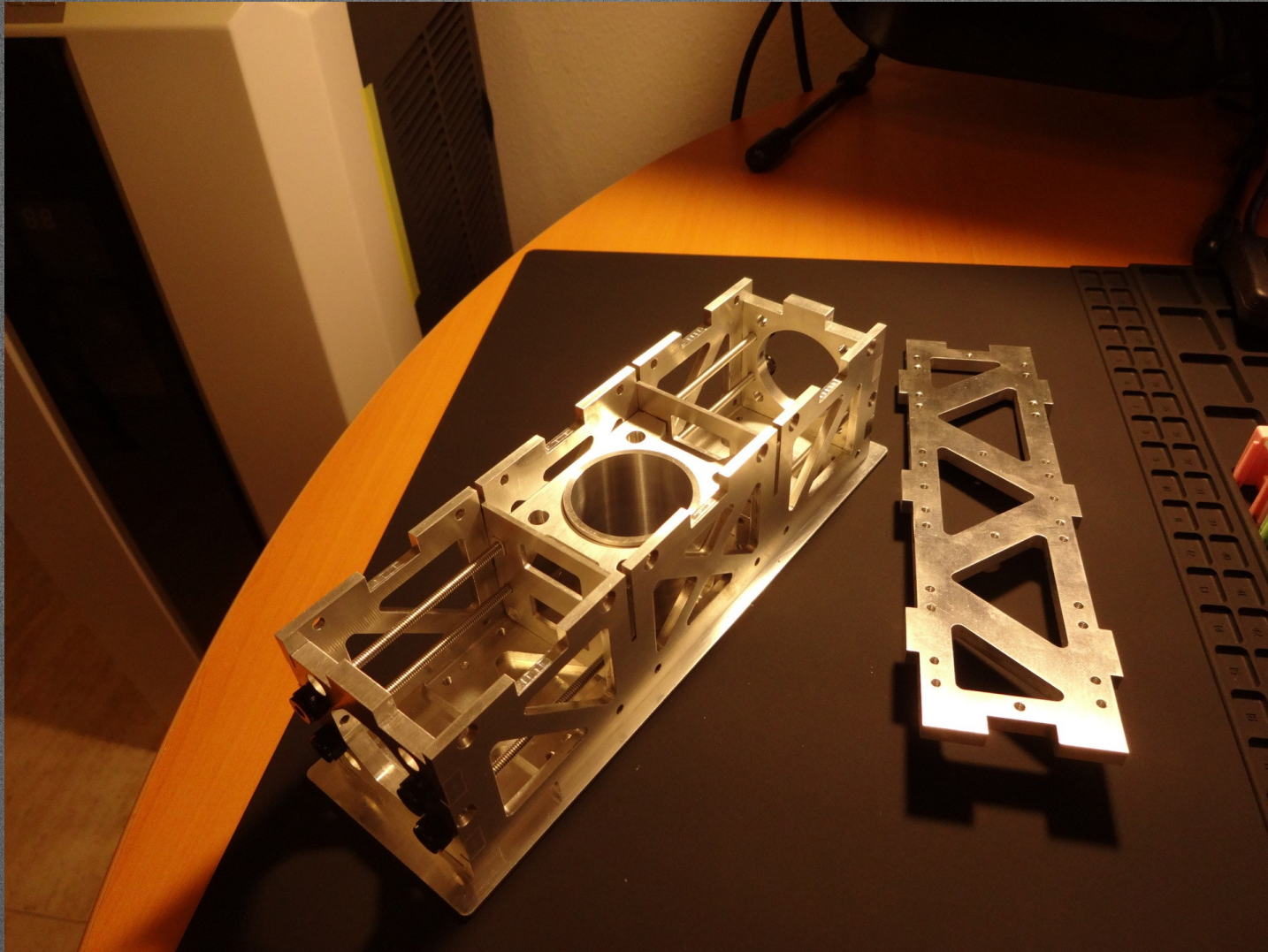


# Details



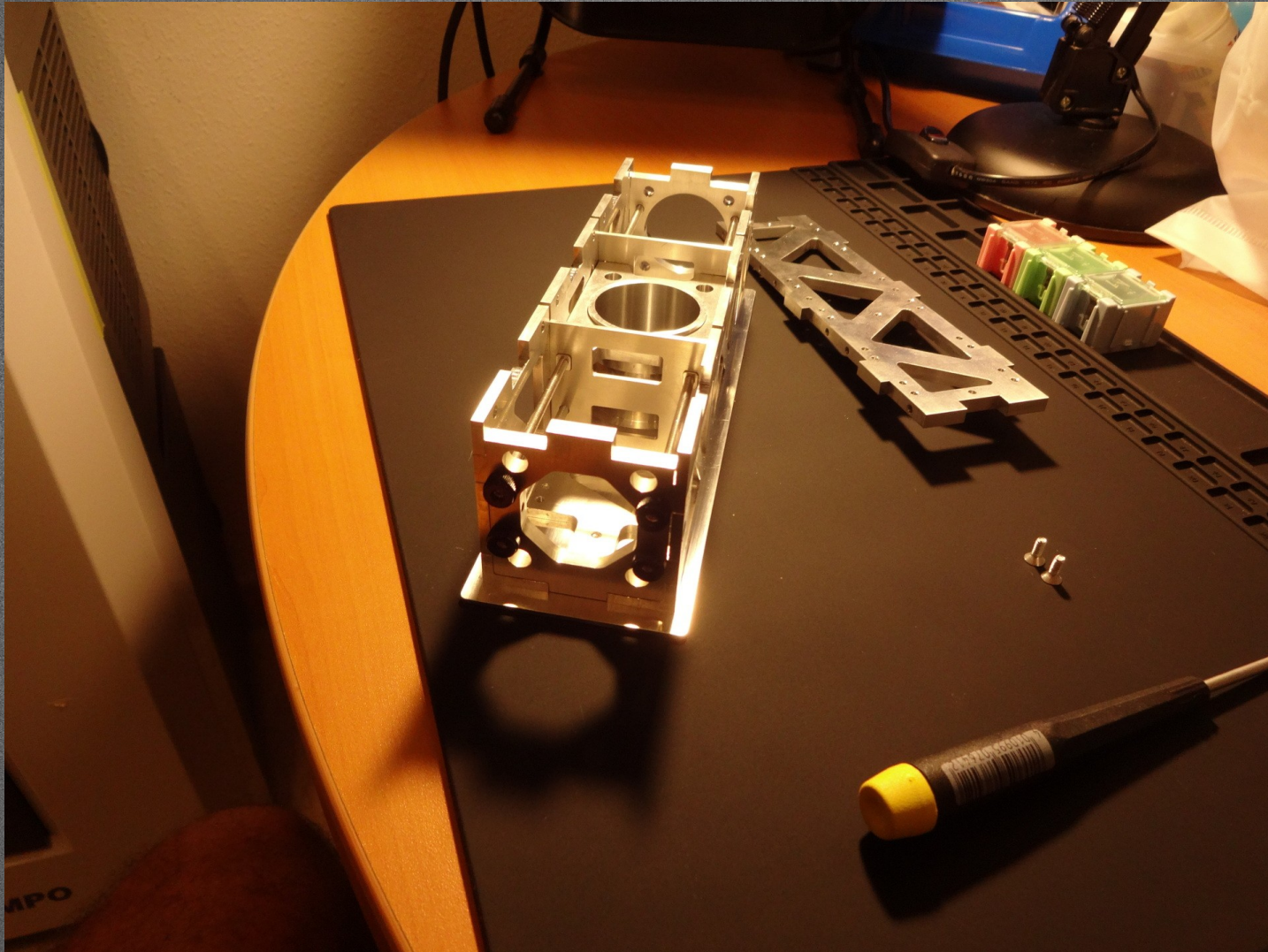


# Details





# Details





# Details





The background features a dark, textured surface with a central horizontal band. This band contains a complex, abstract geometric pattern. It consists of numerous small, glowing blue and white points connected by thin, light blue lines, forming a network or mesh. A prominent, larger, glowing blue polygon is visible on the left side of the band. The overall aesthetic is futuristic and technological.

# Why Nuttx?





# Why Nuttx

We evaluated:

- FreeRTOS
- TizenRT
- ChebiOS
- briefly others (Zephyr)





# Why Nuttx

## Nuttx:

- Support many platforms (more developers)
- Protected build
- POSIX
- Proven reliability
- One of the most active opensource RTOS
- Community support is good



The background features a dark, textured surface with a central abstract graphic. This graphic consists of a network of small, glowing blue and white points connected by thin, light blue lines, forming a complex, web-like structure. A prominent, glowing blue polygon is visible on the left side of the network. The overall aesthetic is futuristic and technological.

# Nuttx duties



# Nutttx duties

2 phases:

1

After  
deploy

2

In mission  
duties





# NuttX duties

## 1. After satellite deploy:

- Timing the panels deploy
- Enable the power supply buses
- Enable OBC with Linux
- Enable RF modules
- Send telemetry with alive signal





# NuttX duties

## 2. During the mission:

- Monitor current consumptions
- ADCS: sensors reading
- ADCS: drive the actuators
- Temperature monitoring
- Watchdog for the Linux OBC
- Send telemetry



The background of the slide is a dark, textured grey. A central horizontal band features a complex, abstract geometric pattern. This pattern consists of a network of thin, light blue lines connecting numerous small, glowing blue dots. A prominent, larger, semi-transparent blue triangle is positioned on the left side of this network. The word "Challenges" is written in a large, white, sans-serif font, centered within the horizontal band.

# Challenges





# Challenges

- Correct prioritization of tasks
- Safe userland in protected environment
- Lowest power consumption
- Develop new drivers





# Challenges

## Correct prioritization of tasks:

- The case of the MARS pathfinder spacecraft

<https://www.rapitasystems.com/blog/what-really-happened-to-the-software-on-the-mars-pathfinder-spacecraft>





# Challenges

## Protected build:

- Separate the userland from the kernel space
- → “FOTA”
  - Increase recovery capabilities
  - Continuous optimization
    - more robust runtime





# Challenges

Lowest possible power consumption:

Critical feature in space missions

- Less weight → cheaper to launch
- Bigger power budget → Increase capabilities of the spacecraft
- Safer





# Challenges

## Development of new drivers:

submit patches for the approval

- to Nuttx mainstream
- Expose new code to the Nuttx community
- → A lot more of testing

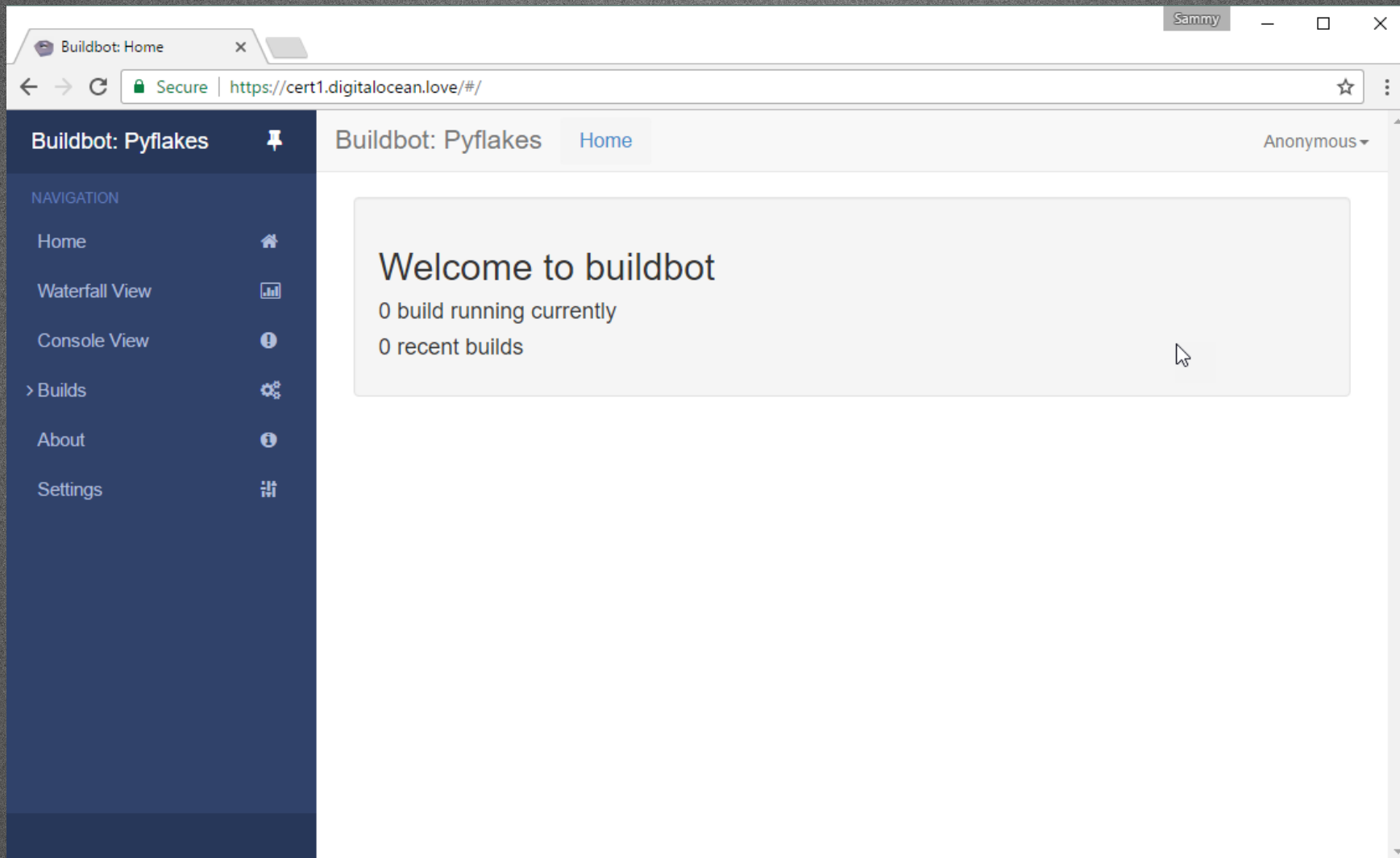




# Our testing system



# Testing system







# Testing system

## Buildbot features:

<https://buildbot.net>

- Python based
- GIT friendly
- Adding custom script is easy
- De-localization of builds
- Logic organized in recipes





# Testing system

## How we use Buildbot:

- Not CI!
- Great for automation
- Building test for the kernel space + userland
- Distribution of releases





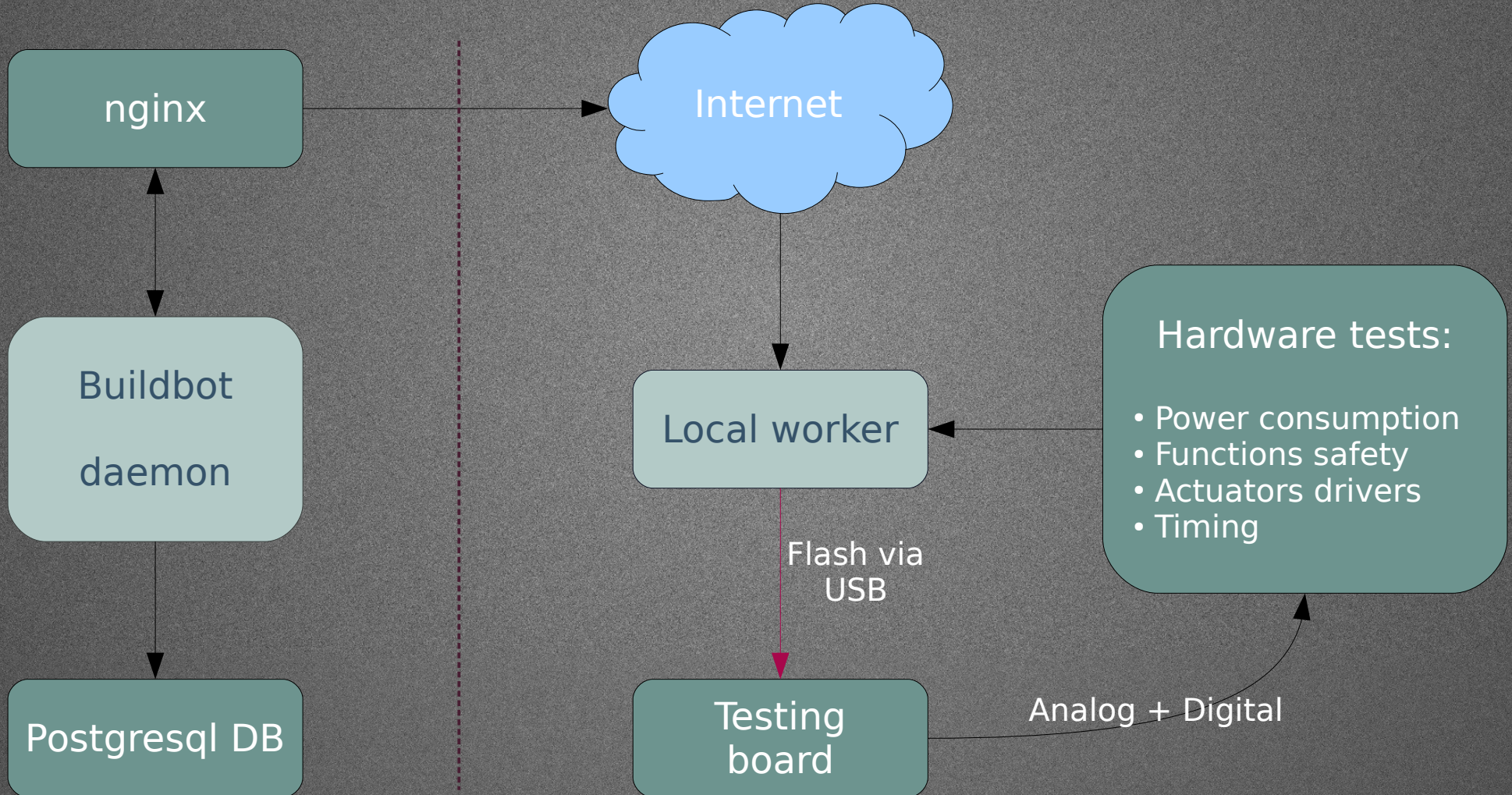
# Testing system

## Buildbot:

- automate the building
- automate the hardware testing
- Track differences with hardware measurements
- It alerts if the procedure goes wrong



# Testing system







# Summary

Nutttx is at the heart of our platform.

100% trustful implementation is required.

We follow the Nutttx mailing list.





# Questions?

<https://stara.space>

CONTACT:  
[fabio@elfarolab.com](mailto:fabio@elfarolab.com)