

IS THE HACK GOODENOUGH?

How far is the hack from the real product?

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Who am I?

Vojislav Milivojevic - Voja

- Almost MEng (FTN - Novi Sad)
- Open source hardware and software engineer
- Research and Development Engineer at Institute IRNAS
- github: VojislavM
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Anyone who cannot understand that a useful science
can be built on a stunt hacking will not understand
this book, either.

PoC||GTFO



Presentation outline

1. Introduction
2. How it all began - The first hack
3. Discussion of design choices
4. Open source in hardware
5. Keep an eye out for lessons learned
6. ASK QUESTIONS!
7. Touch all the prototypes



Organizations

- **Institute IRNAS** - Non-profit research and development organisation
Maribor, Slovenia Novi Sad, Serbia
- **Fabrikor** – Fabrication lab

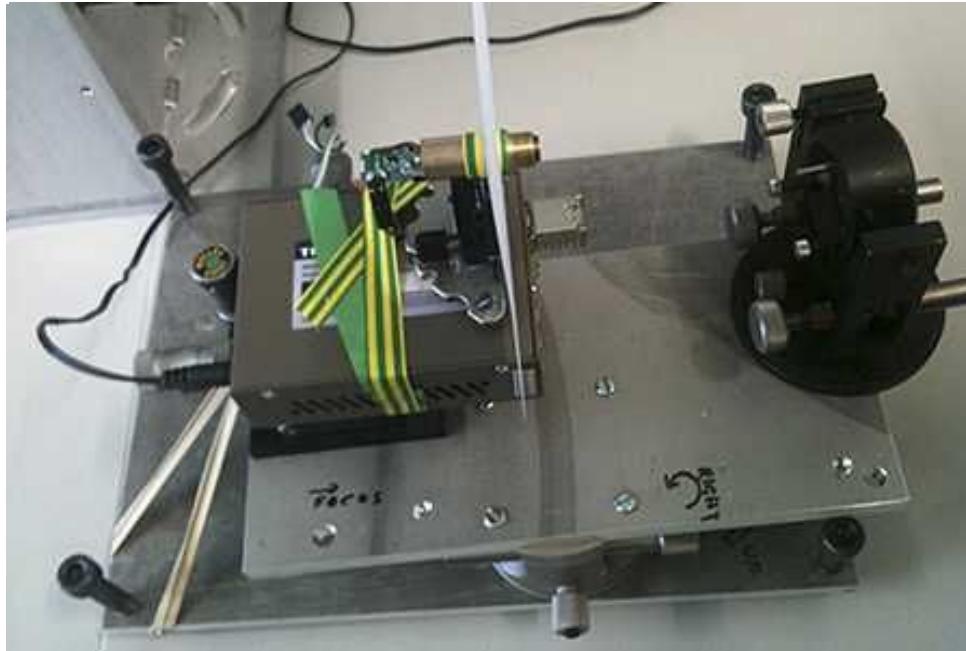


Main projects

- **KORUZA** - Wireless optical communication
- **Vitaprint** - Open source 3D bioprinting
- **Symbiolab** - Open hardware bio lab
- **GoodEnoughCNC** - Affordable manufacturing toolset (past)



First prototype

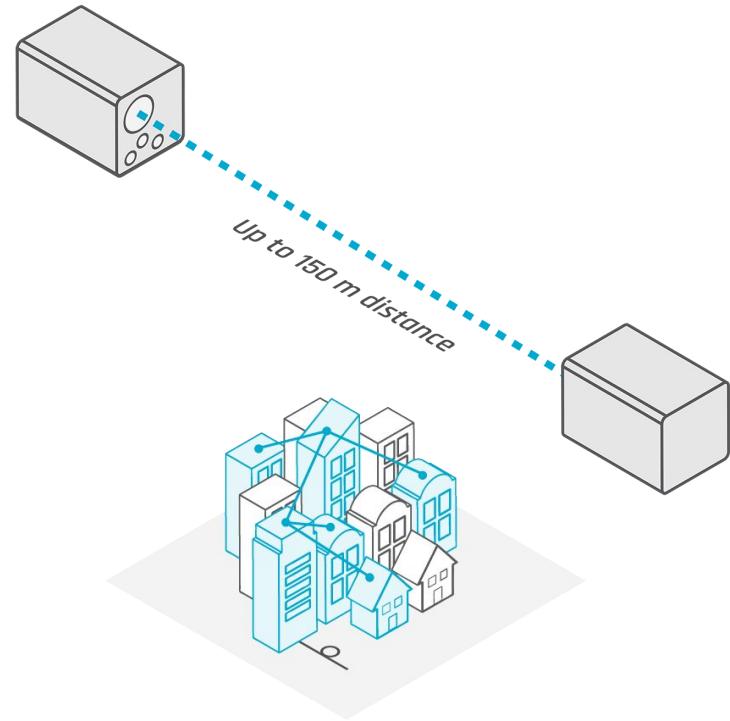


KORUZA

Open source open hardware wireless optical communication system.

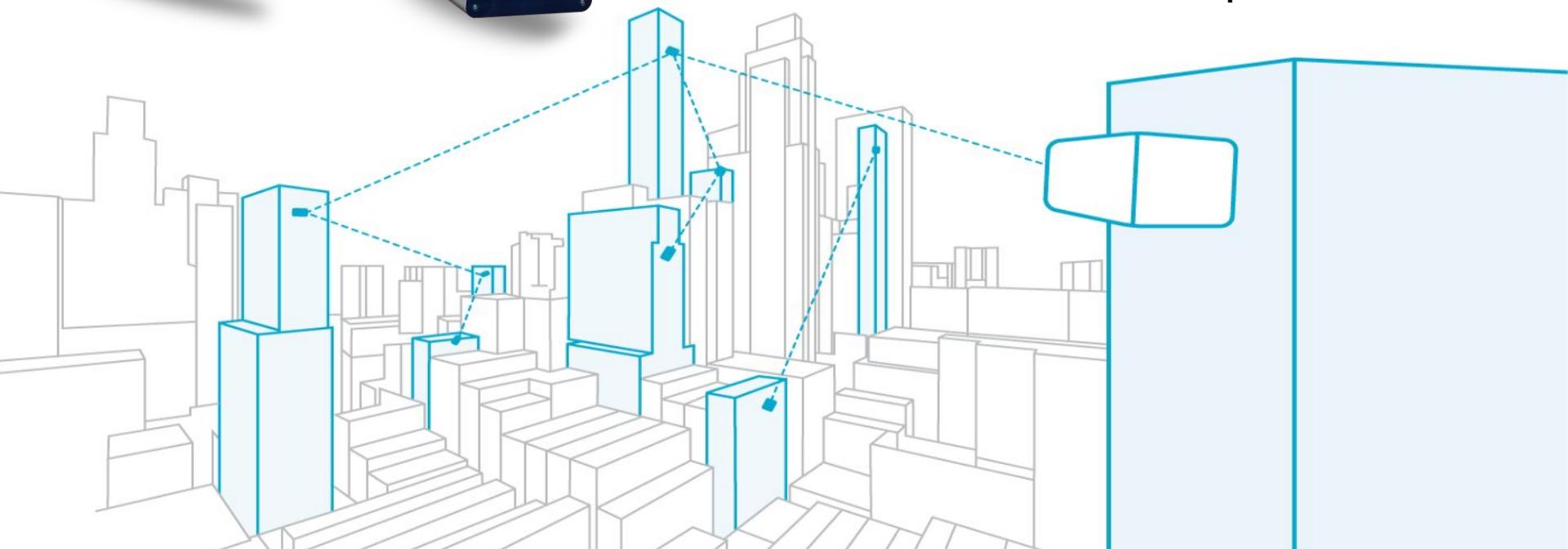
Data is securely transmitted point-to-point over a collimated beam of light at 1 Gbps or 10 Gbps throughput at distances up to 150m.

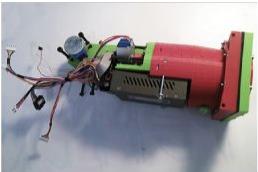
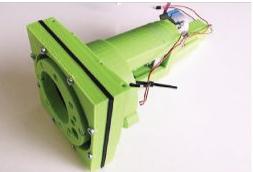
KORUZA is the first affordable free-space optical system (FSO), enabling next generation last-mile connectivity and versatile installation options.





Light-speed networking.
No cables, no congestion.
Ten times cheaper.





2012

2013

2014

2015

2016

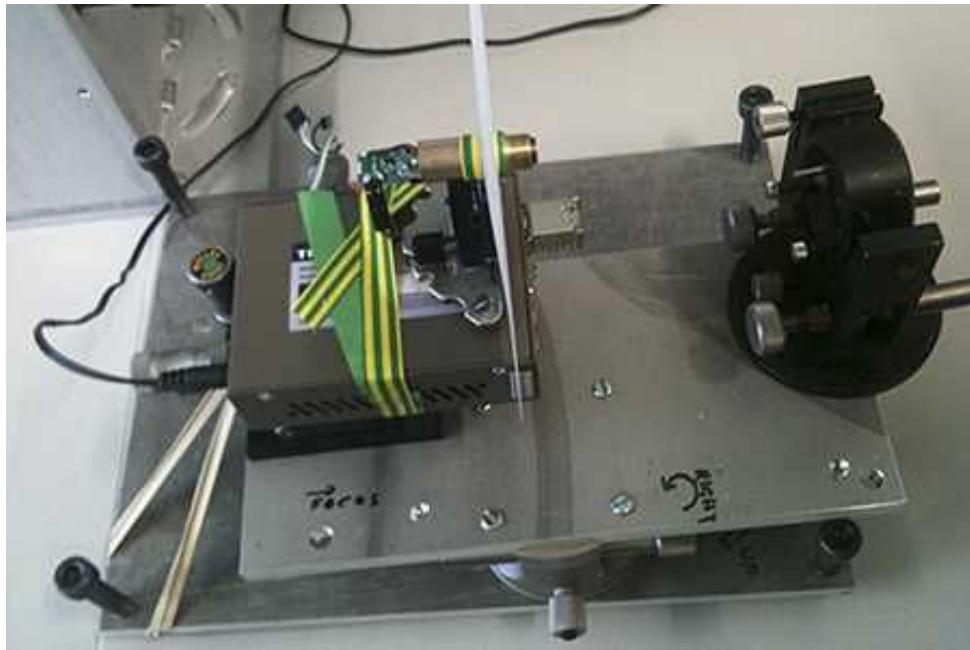
SCIENTIFIC
RESEARCH

SEVERAL GENERATIONS OF PROTOTYPES

KORUZA 1.0
SCIENTIFIC AND RESEARCH &
DEVELOPMENT PLATFORM

We have pioneered the use of commonly available parts to
create cost effective solutions.

First prototype



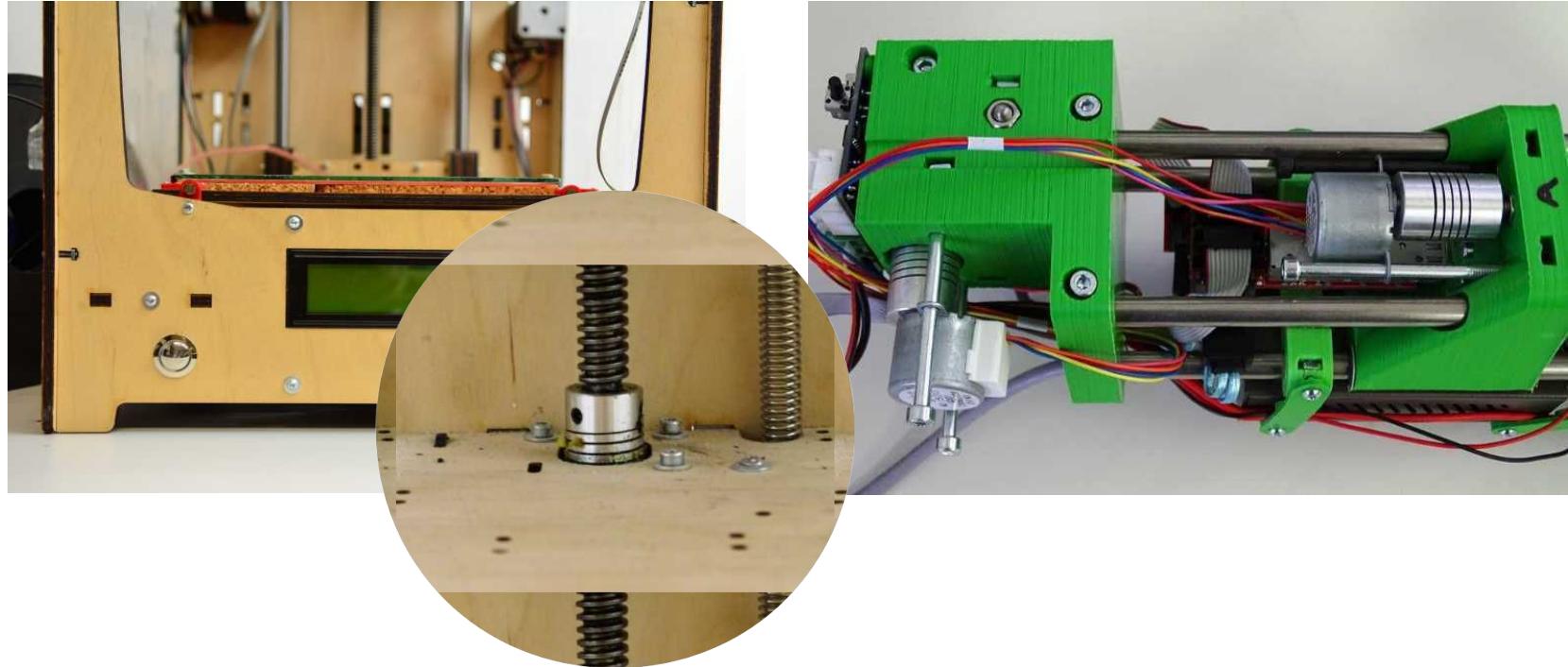
Second prototype



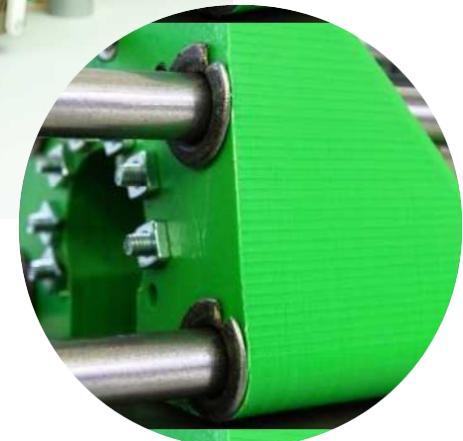
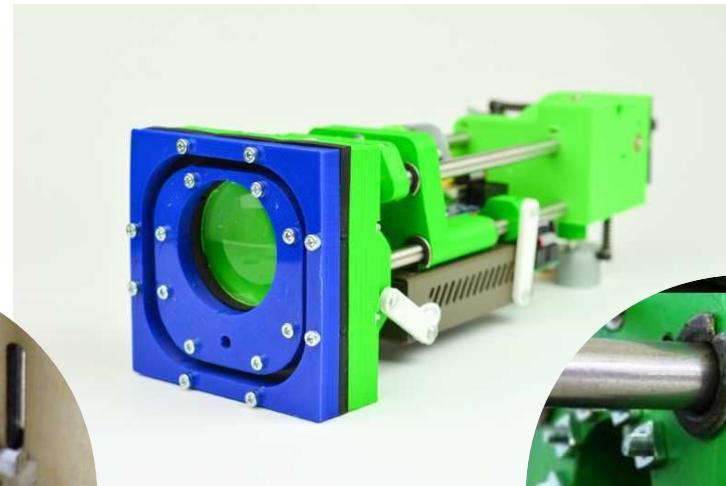
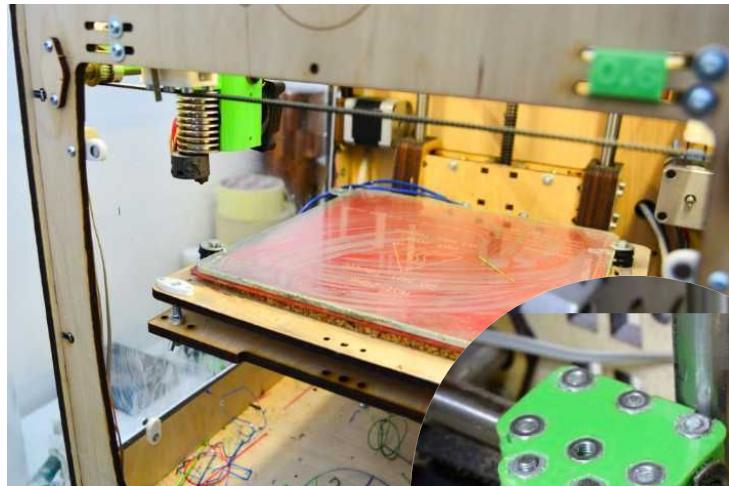
Third prototype



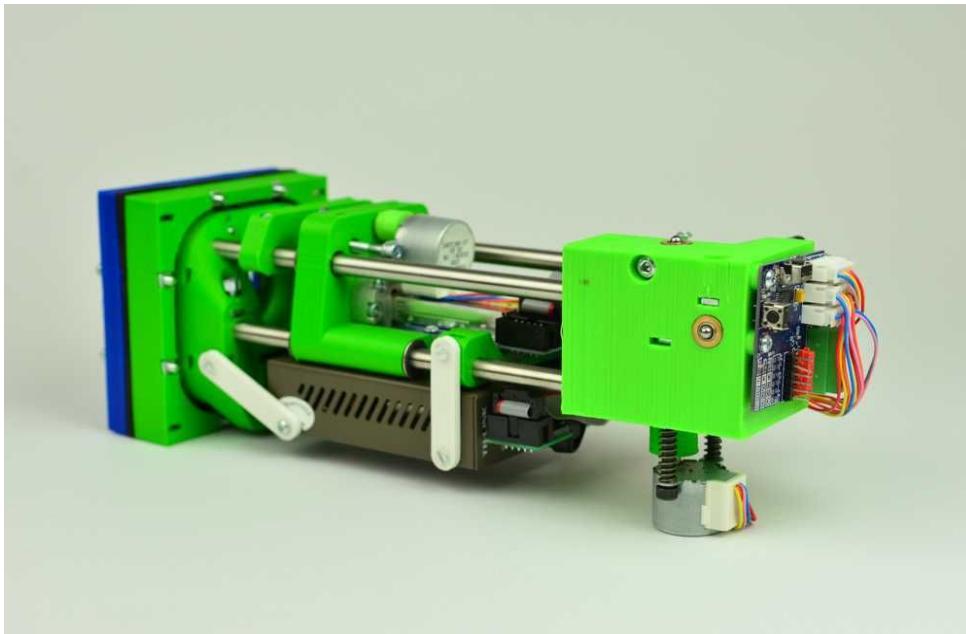
Using spring couplers from Troublemaker in KORUZA



Using sliding bushings from Troublemaker in KORUZA



KORUZA 1.0



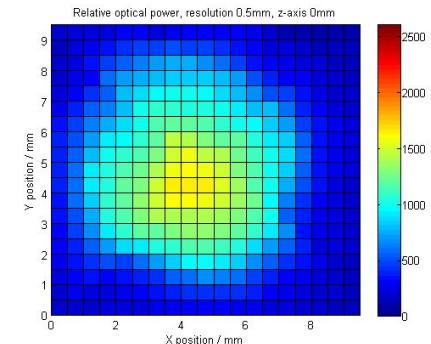
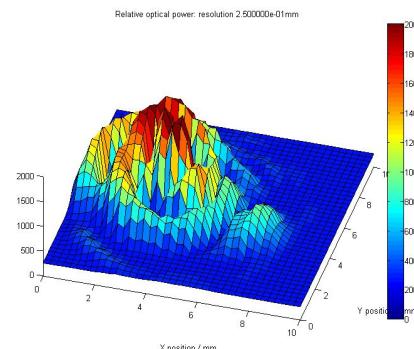
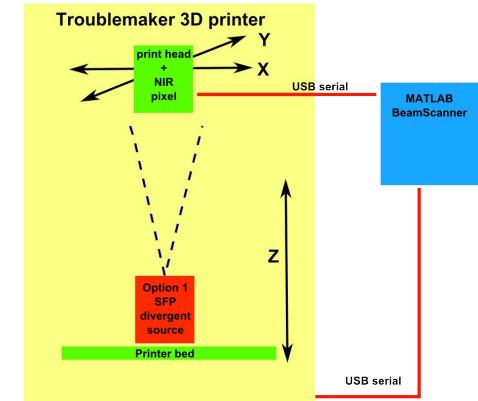
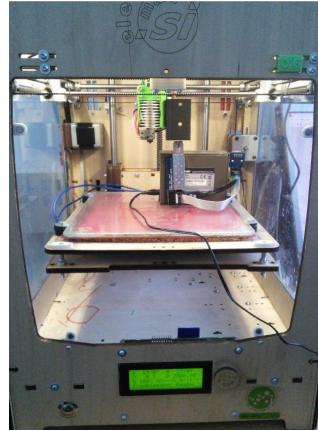
KORUZA 1.0

- Fully modular mechanical design.
- Enables easy modification for a variety of use cases.
- Improved stability and reliability.
- 3D printed parts designed in OpenSCAD environment.
- Interconnection with stainless steel rods.
- Automatic alignment and tracking.
- Available as a DIY kit.



Beam scanner and papers

- *Cerncic, E., Mustafa, L., & Thomsen, B.. (2016). FSO artificial low-cost fog attenuation experiment design.* CSNDSP.
 - *Cerncic, E., & Mustafa, L.. (2015). Low-cost NIR measurement device.* IWOW.
 - *Mustafa, L., & Thomsen, B.. (2013). Reintroducing Free-space Optical technology to Community Wireless Networks.* AMCIS.



Test network and fog tunnel



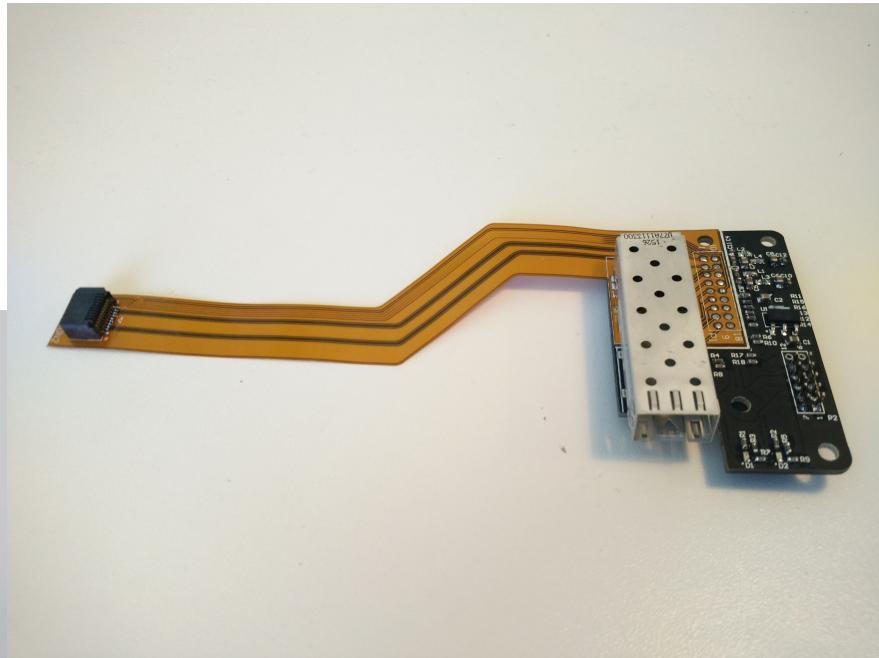
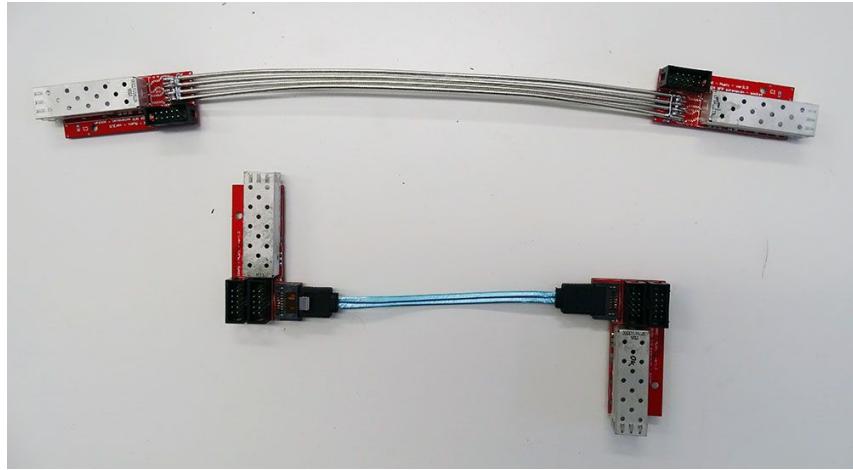
KORUZA 2.0 Pro

- Design for manufacturing (DFM)
- Easy to setup
- Easy to maintain
- Cheap to produce
- 1G and 10G version



Koruza 10G

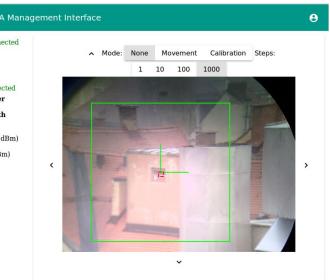
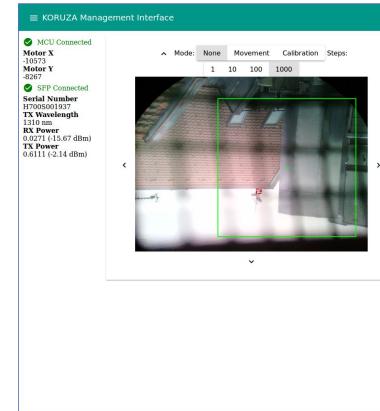
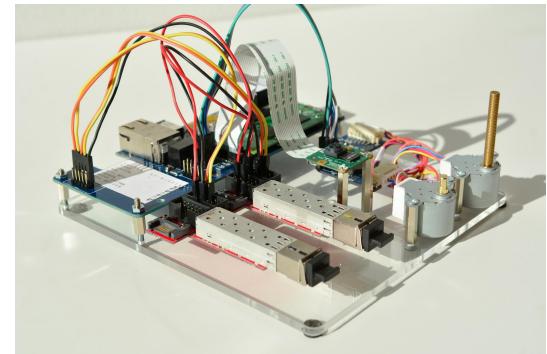
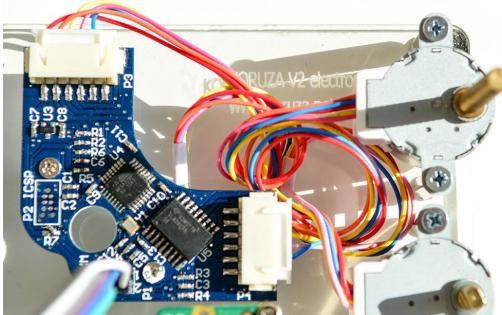
- Is it possible
- how to do it cheap



Koruza CPU

- costum hardware
- hard to add new features
- complicated hardware





Open source hardware

Openes comes together with total ownership allowing full use and repair of existing products as a complete insight into operation is available.



TOTAL OWNERSHIP



FUTURE-PROOF



COLLABORATIVE DESIGN

It ensures the devices are **future proof**, since they are designed and documented such that users are empowered to innovate, explore and upgrade them outside the original specification. The lifespan of devices is extended, their reuse encouraged and their open hardware documentation an enabling component in communication between all parties involved.

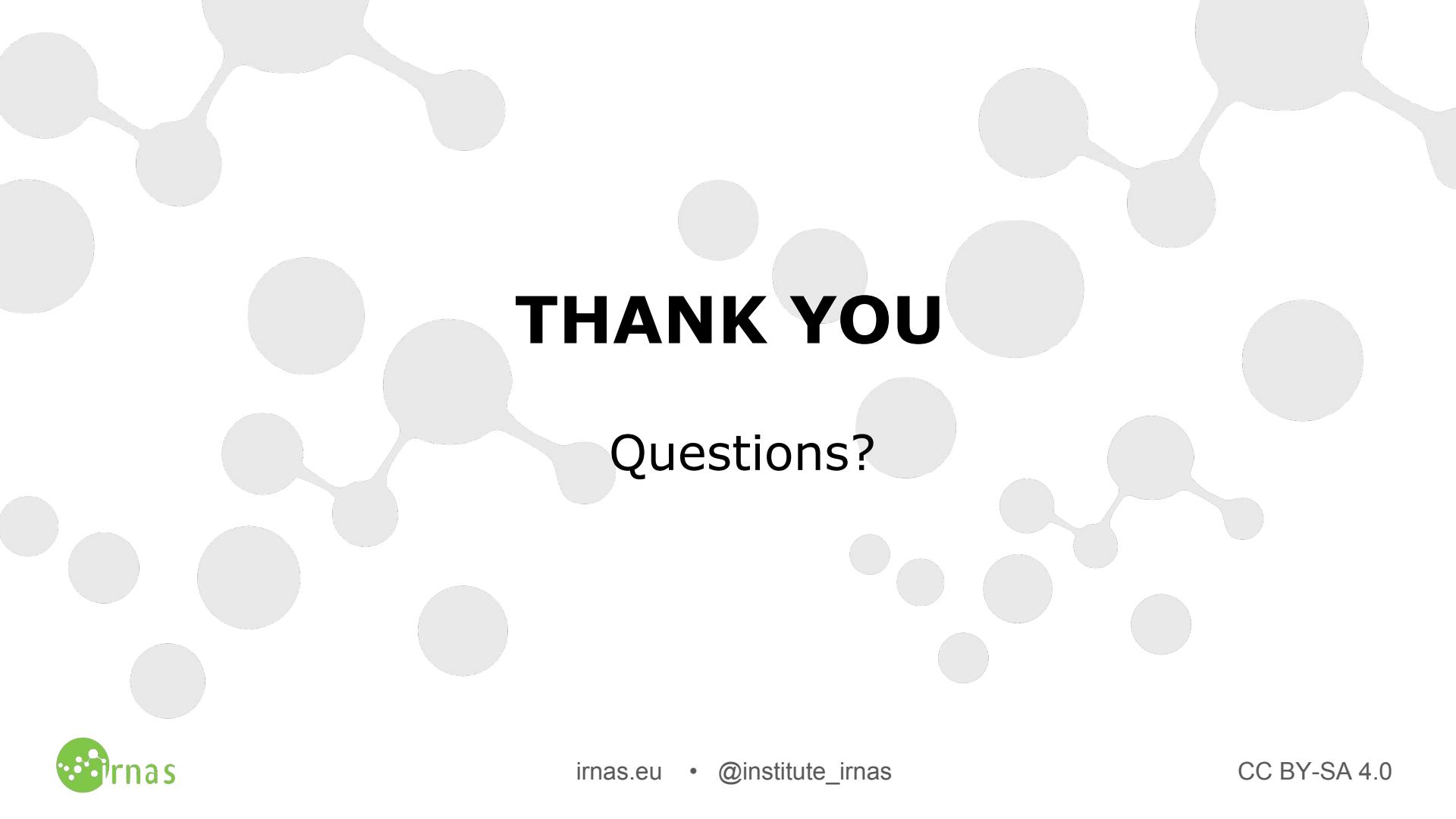
It also simplifies **collaborative design**, bridging the gap between the development, manufacturing and use of a device, enabling evolution of the product to be optimal for everyone involved.

Iterate fast



KEY GUIDELINES FOR OPEN HW DESIGN

- **Expect unexpected** uses and support them
- **Modularize** to simplify
- **Add debug features**, connectors and more
- **PCBs are cheap**, do not make them smaller
- **Document iterations** so others can learn
- **Serial numbers + check lists** are your friend



THANK YOU

Questions?

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