

Repeatable replication and reliable operation of open hardware

Useful source approach demonstrated through KORUZA and other systems under development



Who am I?

- Luka Mustafa - Musti (MEng)
 - electronics, telecoms, hardware hacking, ...
 - Institute IRNAS Rače (non-profit development)
- Shuttleworth Foundation Fellow
- University College London: PhD student
- Also active in :
 - HAM radio S59DXX
 - wlan slovenija



RADIOKLUB
STUDENT
S59DXX



wlanslovenija



SHUTTLEWORTH
FELLOW



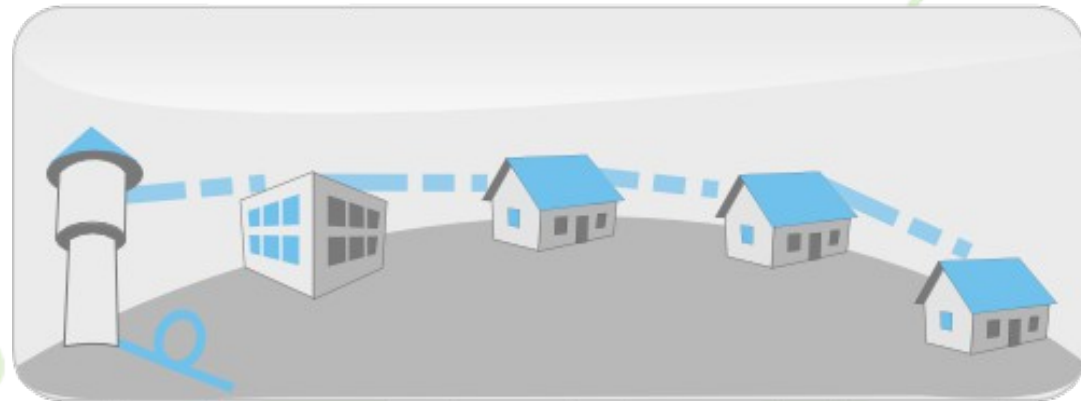
Institute IRNAS Rače

- Non-profit development lab focusing on open technologies
- KORUZA – wireless optical communication system for 100m/1Gbps links
- GoodEnoughCNC machines for low-cost manufacturing
- Troublemaker 3D printer
- Various tools, measurement devices...
- **KEY CHALLENGE: Releasing and documenting our work for maximal impact**



KORUZA wireless optical

- Alternative for RF congested areas
- End-user deployed last-mile networks
- Open-source open-hardware for anyone to build
- Release planned for Wireless Battle of the Mesh 3rd-9th August



Creating an ultrafast wireless optical network.

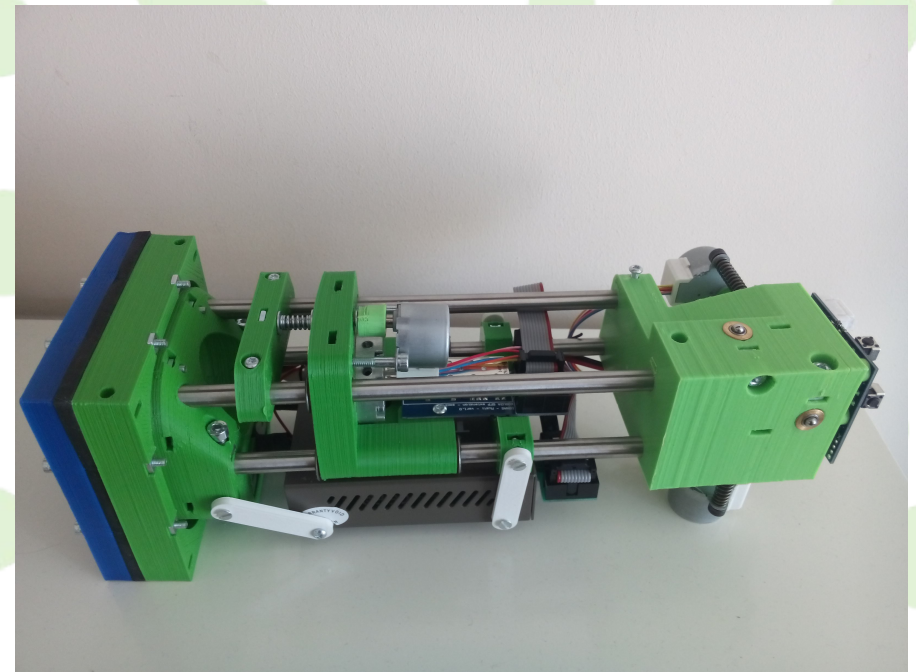
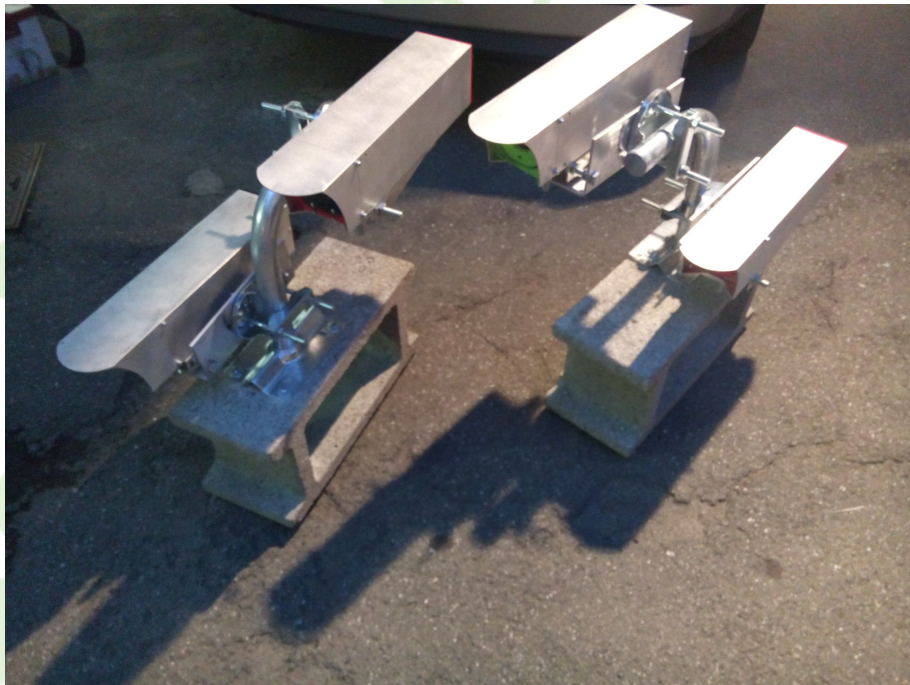
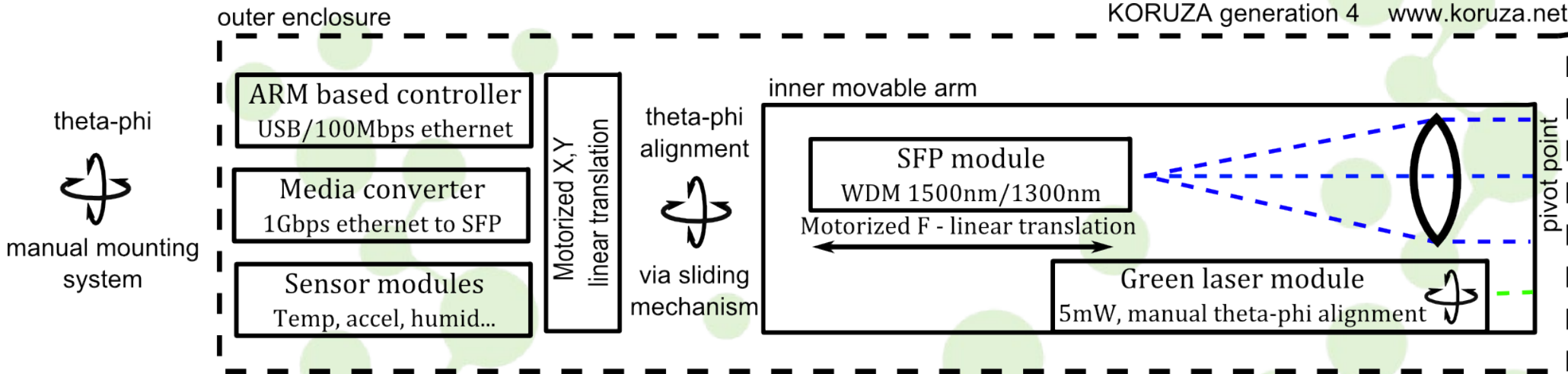


Increasing the capacity of community wireless.



KORUZA system

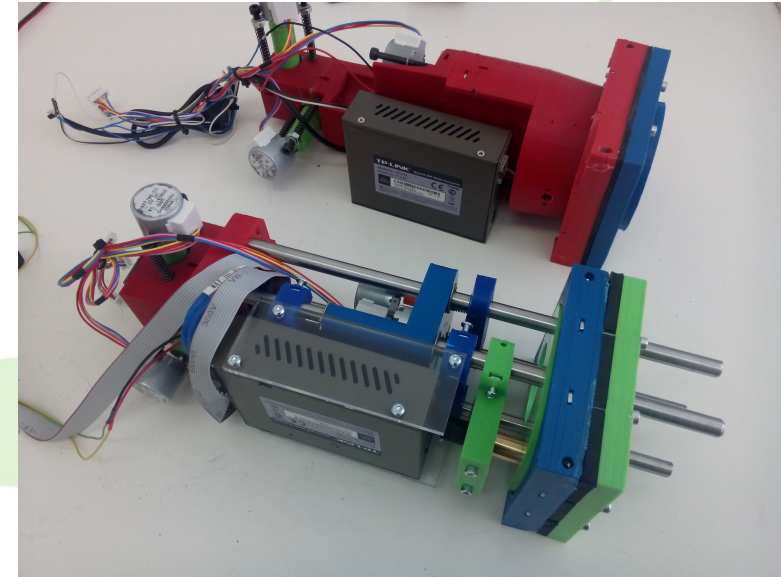
KORUZA generation 4 www.koruza.net





KORUZA modular assembly

- 12 different 3D printed parts
- Precision alignment system
- 4 modular electronics boards
- SFP optical module
- DPSS green laser
- WiFi router and expansion board



We aim for researchers to be able to replicate the system, understand operation and be able to modify it.



Troublemaker 3D printer

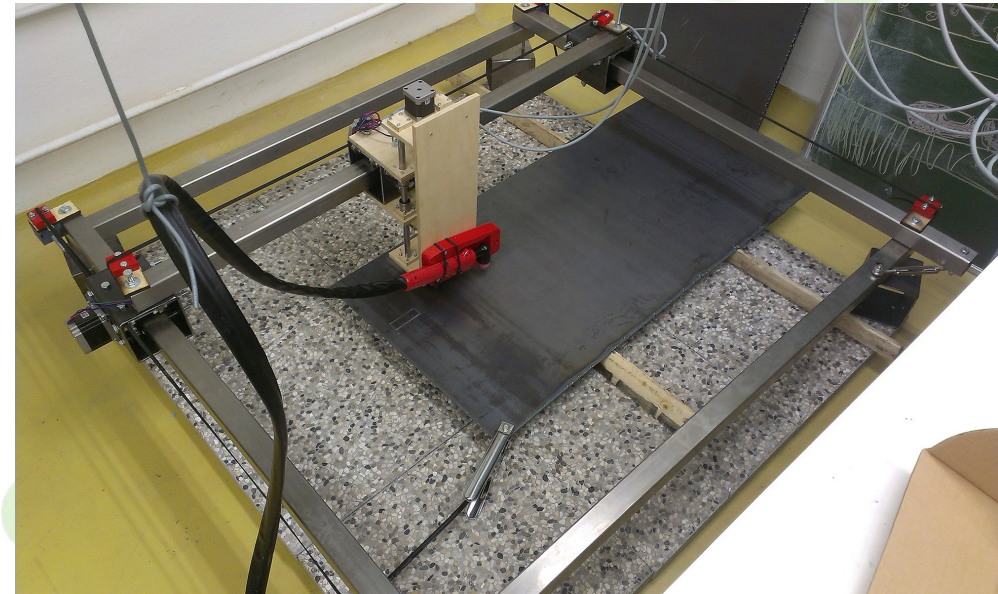
- <http://www.thingiverse.com/thing:263814>
- Ultimaker Classic derivative
- Reworked enclosure
- Heated bed/chamber upgrade
- Effectively open-source
- 80+ built in society Društvo Elektronikov Slovenije
- **Next generation under development**





GoodEnoughCNC Plasma cutter

- Based on stock steel profiles
- Low-cost with sufficient performance
- Innovative fiber optic control and torch height control operating even with lowest cost cutters
- Complete machine in 700GBP range
- **Close to release**



Under development 10k fab:

- Plasma cutter
- CNC mill (2x3m)
- Laser cutter 100W (2x3m)
- 3D printer
- Waterjet cutter



State of open hardware today

- A large number of projects
- Questionable quality
- Difficult to replicate
- Difficult to document
- Open hardware focused on modifications and hacks not replication
- Of limited use for scientific applications
- Most replicated systems are not calibrated and results can not be compared



Problems we face

- No good documentation practice
- How to interconnect documentation and design files
- Confirming that replication works as expected
- Being able to receive help when it does not work
- Understanding projects we try to replicate
- Every replication is a fork, modifications during construction are lost

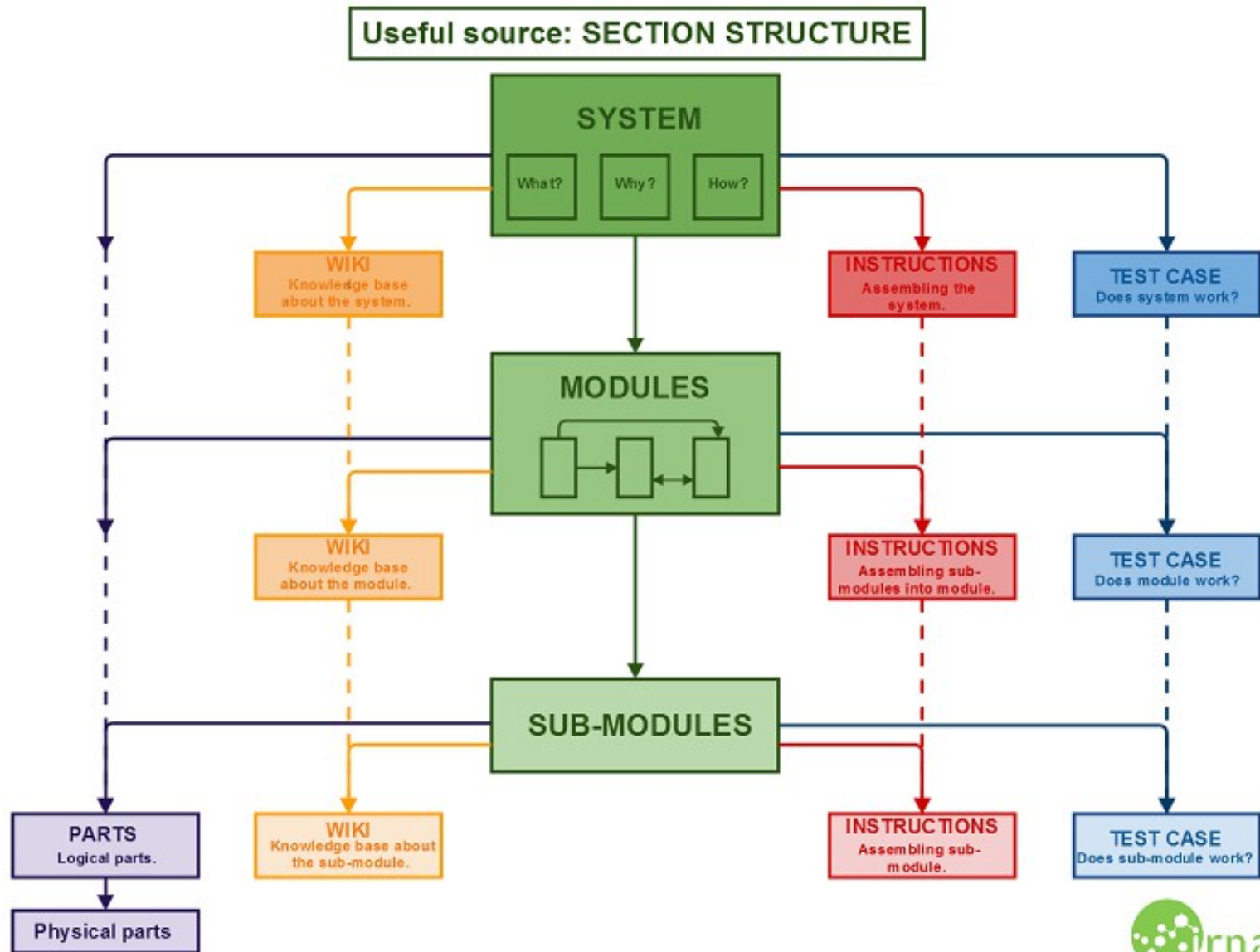


Useful source

- Tree-structure approach start from one page and follow through to source
- System breakdown into modules
- Assembly instructions and test-cases for every module
- Breakdown of parts into logical (function) and physical (implementation)
- To be built using XML, interactive documentation for offline use
- Content and display style are separate



Useful source tree





Impact of useful-source

- Well-defined flow from first information about the project to sources and replication
- Automatic wizard-like interface for documenting a project
- Re-use of modules in other projects
- Localization available for physical parts
- Designed for stable well-documented and tested systems



- Implementation of useful source proposal
- Tree-structure of “bricks” consisting of
 - Functions (logical parts)
 - Implementations (physical parts or design files)
 - Multi-level
- Documentation builder application under development
- Envisioning a companion mobile phone app for seamless documentation



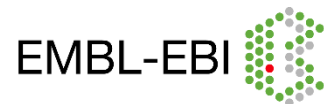
Future of



- Online system/database of open hardware stable releases
- DOI for releases
- Collaboration with open hardware journals
- Documenting/referencing experimental equipment
- Enable sharing of kits for assembly
- API for including projects into other websites

Developed by:

Tobias Wenzel, Dr. Carlos Lugo, Dr. Johan Henriksson, Luka Mustafa





Overall picture

- DocuBricks developed by documenting several IRNAS and other open hardware projects
- Aiming for release in the fall
- Everyone is invited to document their projects
- Open hardware stable release tools, methodology and database for long term use of open-hardware

Questions?

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