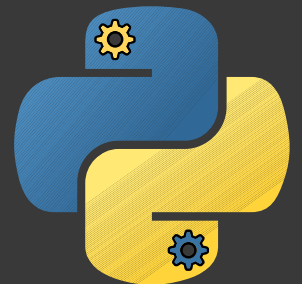


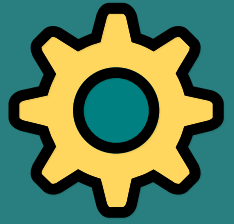


MACHINEKIT

BUILD REAL-TIME SYSTEMS WITH PYTHON

Alexander Rössler





- **Machinekit and HAL**
- **The 4 APIs**
- **Configure and Run**
- **Create HAL components**
- **Interface with the CNC stack**
- **Remote Control Machinekit**

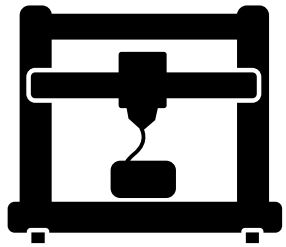
ABOUT ME



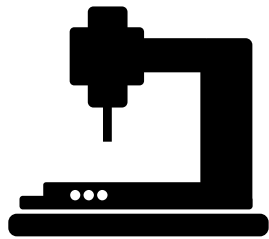
- Alexander Rössler
- Embedded Systems
- All things Open Source
- 3D printing, CNC, robots, ...
- "Solopreneur"



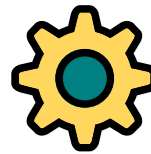
MACHINEKIT AND HAL



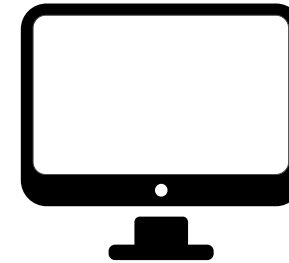
3D Printers



CNC Machines



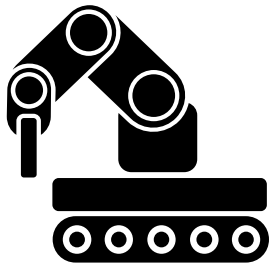
MACHINEKIT



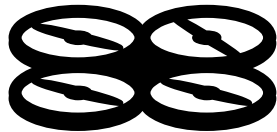
Desktop Computers



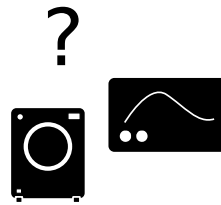
Embedded Devices



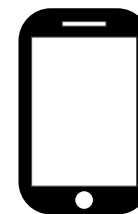
Robots



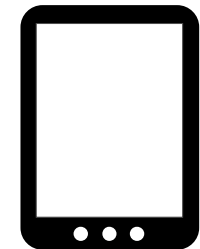
Quadcopters



Other Applications

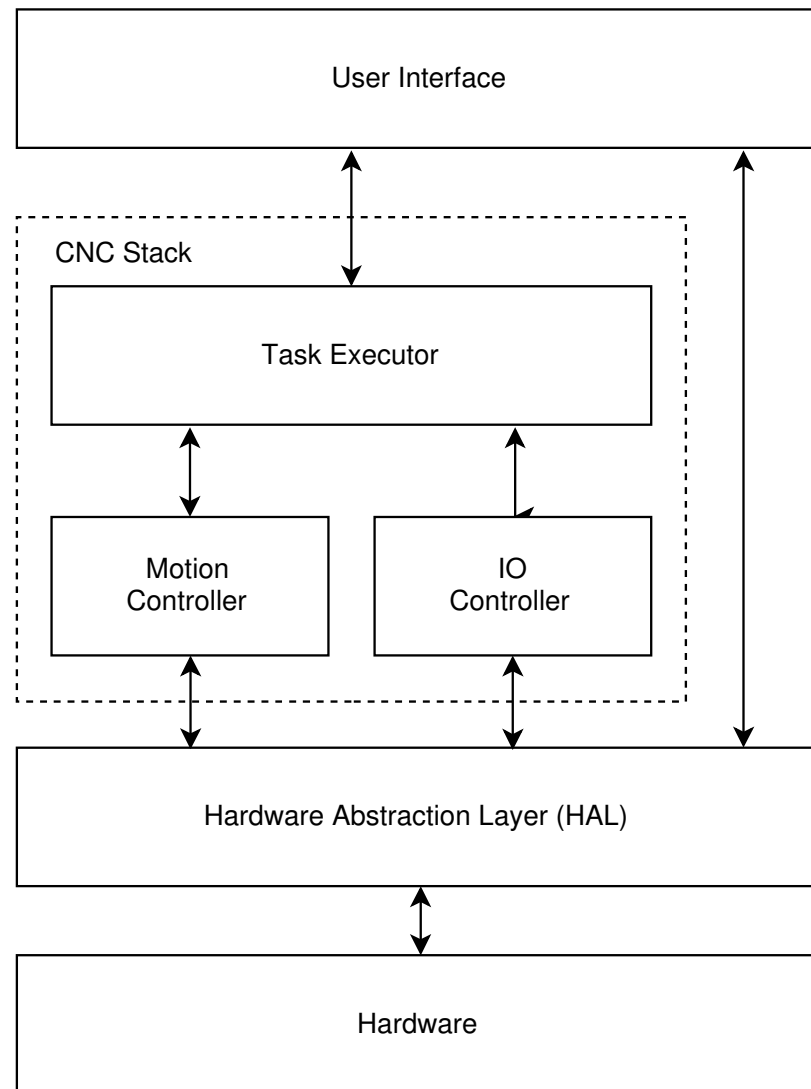


Smartphones



Tablets

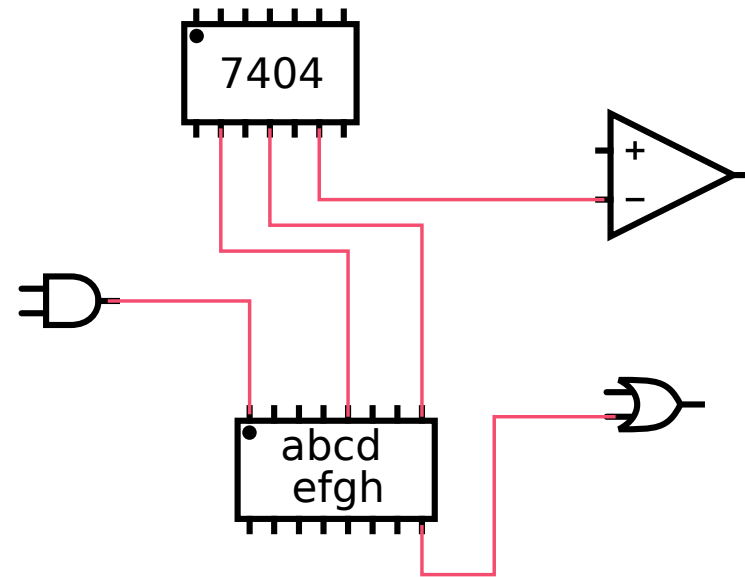
ARCHITECTURE OVERVIEW



HARDWARE ABSTRACTION LAYER



- **Configuration**
 - Components
 - Pins
 - Signals
- **Real-Time**
- **Userland**



WHY MACHINEKIT AND NOT ... ?



- **RT made simple**
- **Portable**
- **Future proof**
- **Runs on Linux**
- **Tools and GUIs**

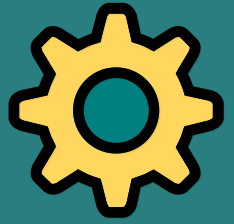


- **Desktop Linux PC**
- **SBCs**
 - BeagleBone (Black, Green, Blue, ...)
 - Raspberry Pi 3
 - Altera and Xilinx SoC/FPGA
 - ...
- **POSIX, PREEMPT_RT or Xenomai**

A large teal speech bubble with a tail pointing towards the bottom-left corner, centered on a dark gray background.

THE 4 APIs

THE 4 PYTHON APIs



- 1) Python HAL and configuration API**
- 2) Python HAL component API**
- 3) Python linuxcnc API**
- 4) pymachinetalk**
- 5) ...**

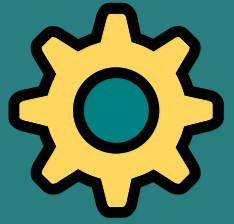
WHAT CAN BE DONE WITH PYTHON



- **Create HAL configurations**
- **Launch and manage Machinekit/HAL instances**
- **Create Userland HAL components**
- **Interface with CNC stack**
- **Remotely interact with HAL**
- **Extend GCode**
- ...



WHAT CAN'T BE DONE PYTHON



- **Create new HAL RT components**



A teal-colored speech bubble with a white border, pointing downwards and to the left. The text "CONFIGURE AND RUN" is centered inside the bubble in a bold, yellow, sans-serif font.

CONFIGURE AND RUN



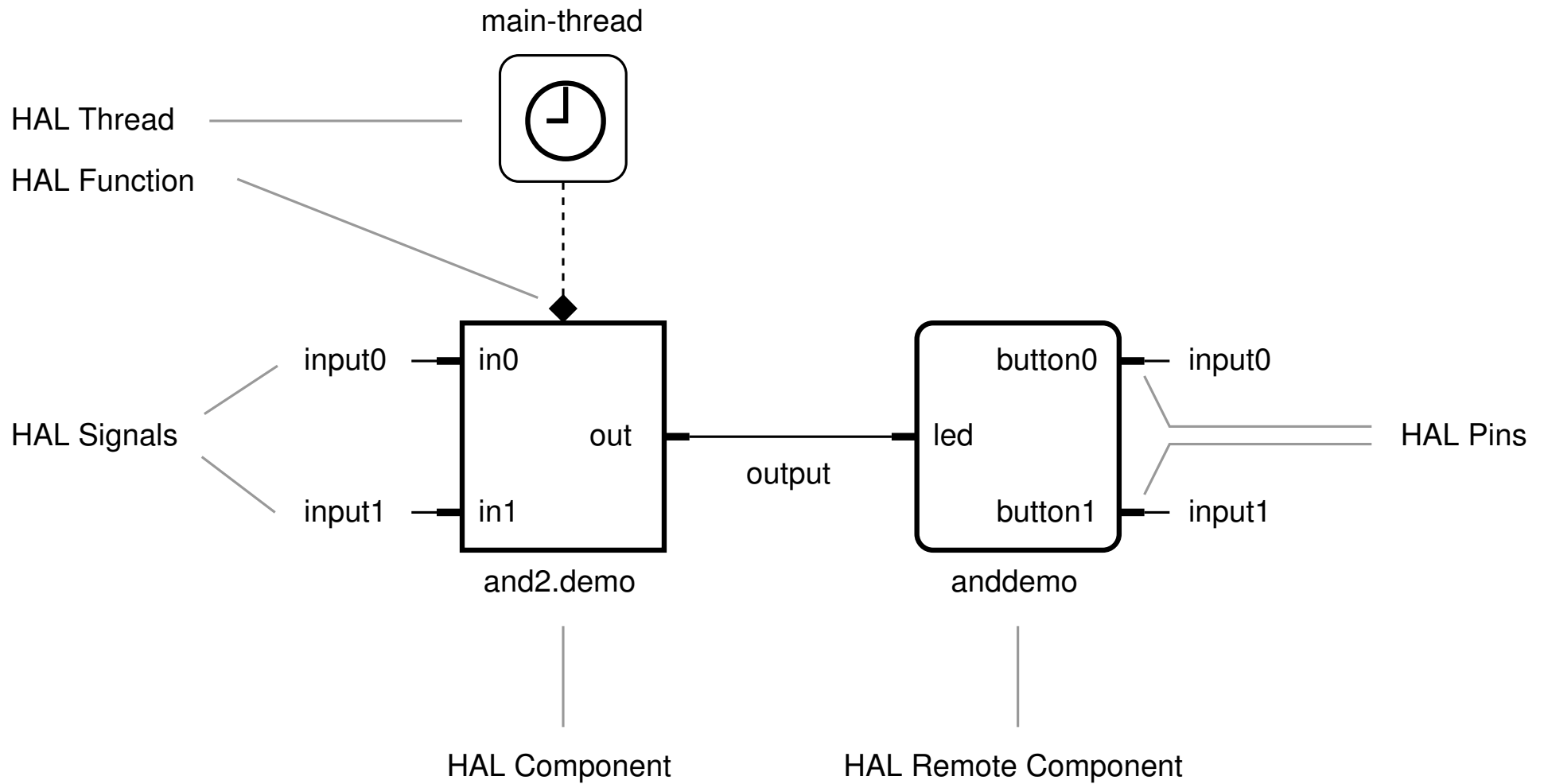
- **import machinekit**
 - config, launcher, hal, rtapi
- **src/hal/cython**
- **lib/python/machinekit**

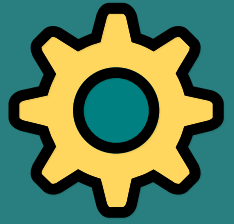
VERY BASIC HAL APPLICATION



- **run.py** - Run file
- **hal_basics.py** – HAL config

HAL BASICS





- **halcmd**
- **halmeter**
- **Halscope**
- **hal-graph**

A teal speech bubble with a tail pointing towards the bottom-left corner, containing the text 'CREATE HAL COMPONENTS' in yellow.

CREATE HAL COMPONENTS



- **import hal**
- **CPython module**
- **Lib/python/hal.py**

SIMPLE HAL COMPONENT



- **import hal**
- **Create pins**
- **Update pins in main loop**
- **custom_sum**
 - $\text{in0} + \text{in1} = \text{out}$


A teal speech bubble with a tail pointing towards the bottom-left corner, containing the text 'INTERFACE WITH THE CNC STACK' in yellow.

INTERFACE WITH THE CNC STACK



- **import linuxcnc**
 - stat, command, ini, positionlogger
- **CPython module**
- **lib/python/linuxcnc.so**

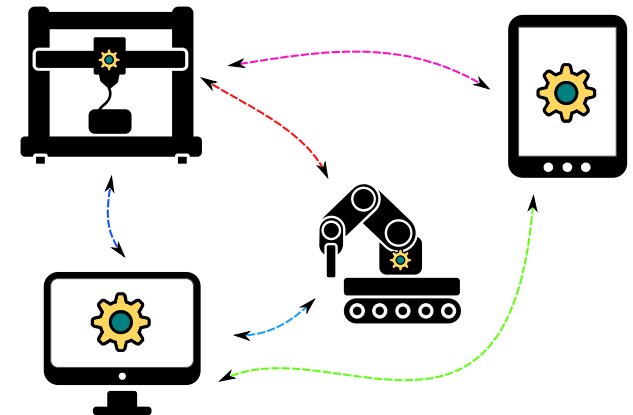


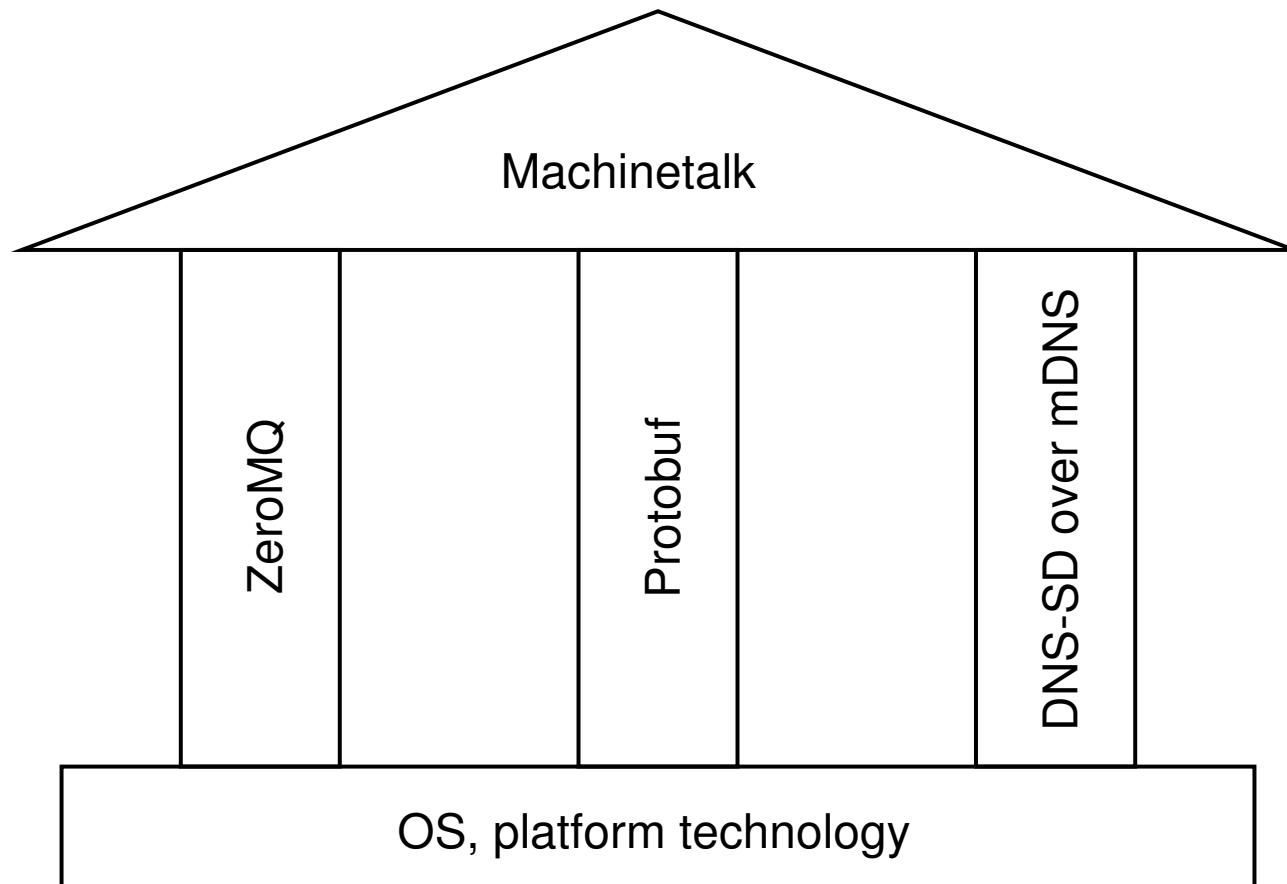
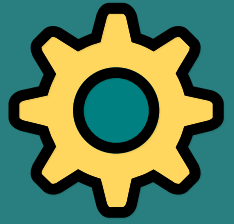
A teal speech bubble with a tail pointing towards the bottom-left corner, containing the text 'REMOTE CONTROL MACHINEKIT' in yellow.

REMOTE CONTROL MACHINEKIT



- **import machinetalk**
- **import pymachinetalk**
 - dns_sd, halremote, application, ...
- **Available on PyPI**
- **Python 3 and 2**
- **Windows, Linux, Mac, ...**

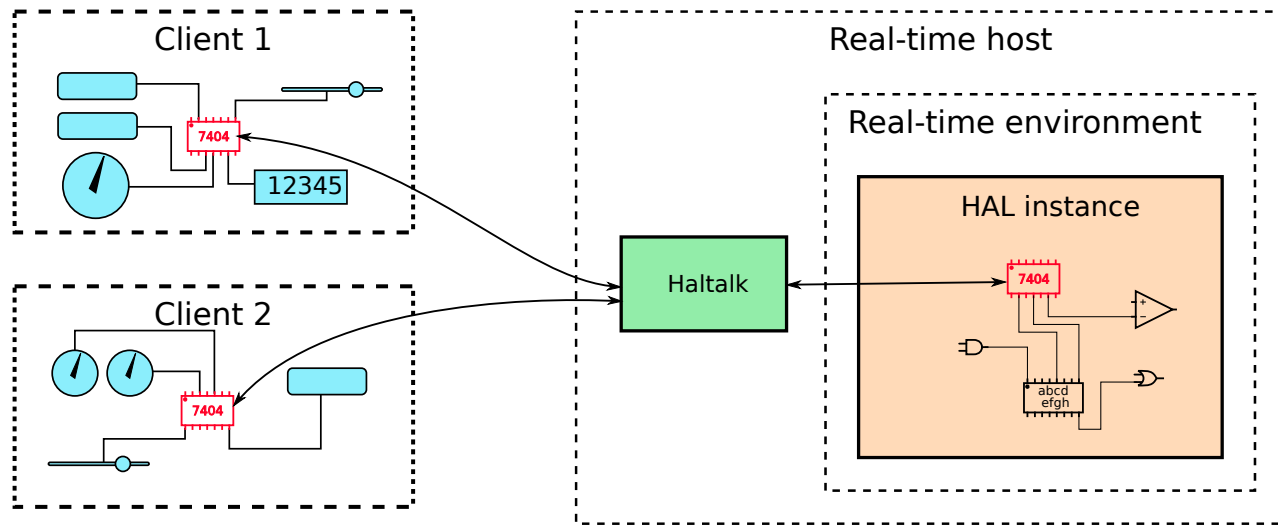




HALREMOTE SERVICE



- halrcomp & halrcmd
- haltalk
- Remote API





- **Testing Machinetaalk**
- **Remoting HAL**
- **CLIs and UIs**
- **Distributed HAL setups**
- **3rd party plugins**

A large teal speech bubble with a tail pointing towards the bottom left, centered on a dark gray background.

QUESTIONS?

MORE INFORMATION



- <http://machinekit.io>
- <https://machinekoder.com>
- Machinekit on Google Groups
- <https://github.com/machinekit>
- <https://github.com/machinekoder/cookiecutter-machinekit-python-hal>
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