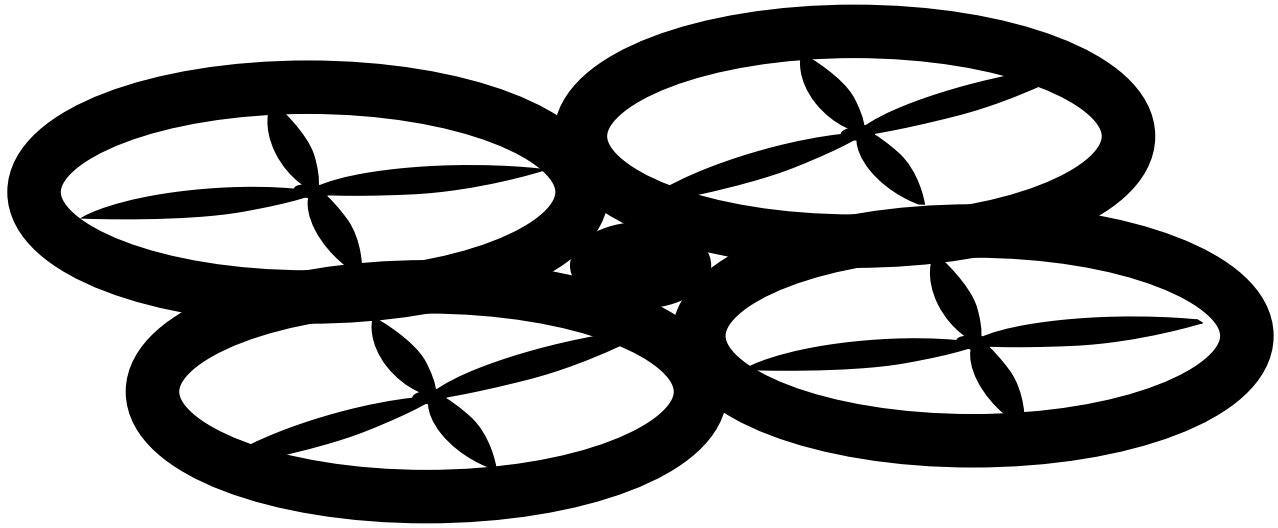
Anwendungen für IoT und Echtzeit

Urs Fässler

8.9.2016



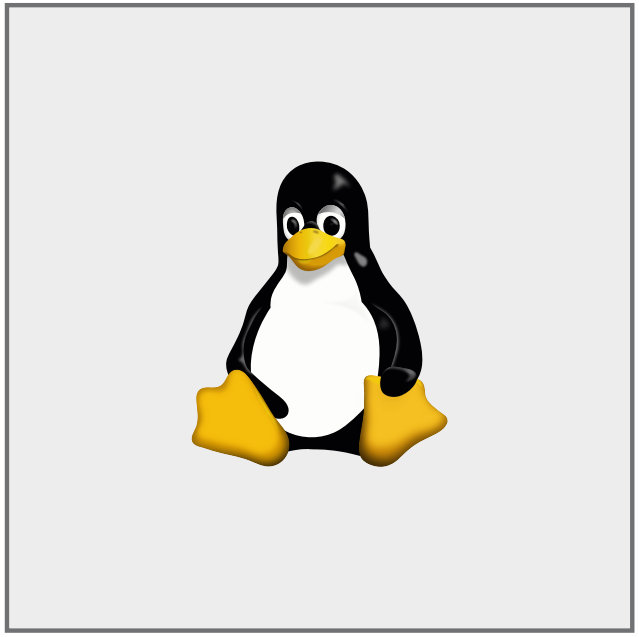
GPS

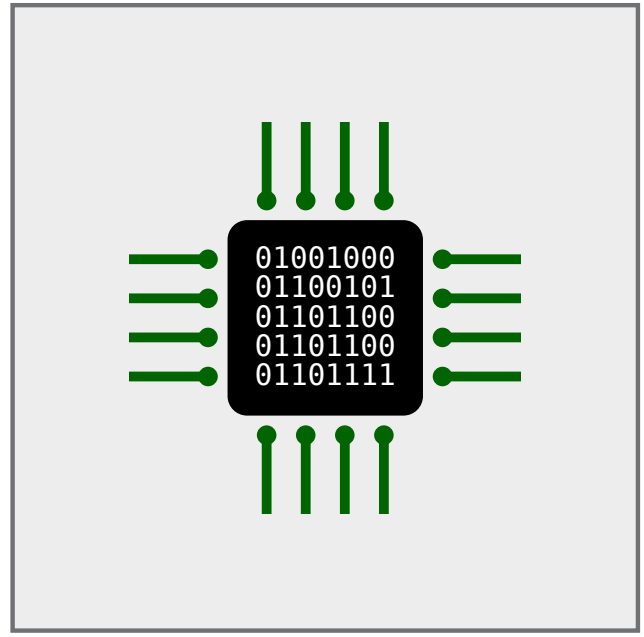
Motorensteuerung

Datenerfassung

Cloud-Anbindung

Asymmetrische Multiprozessorsysteme (AMP)
&
Linux

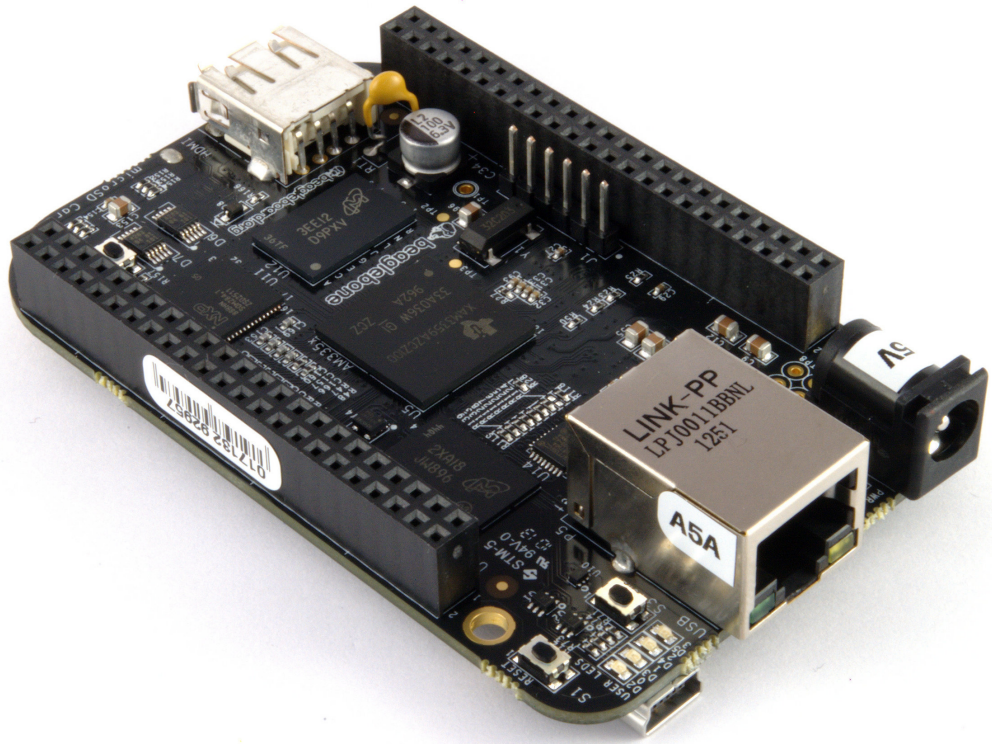


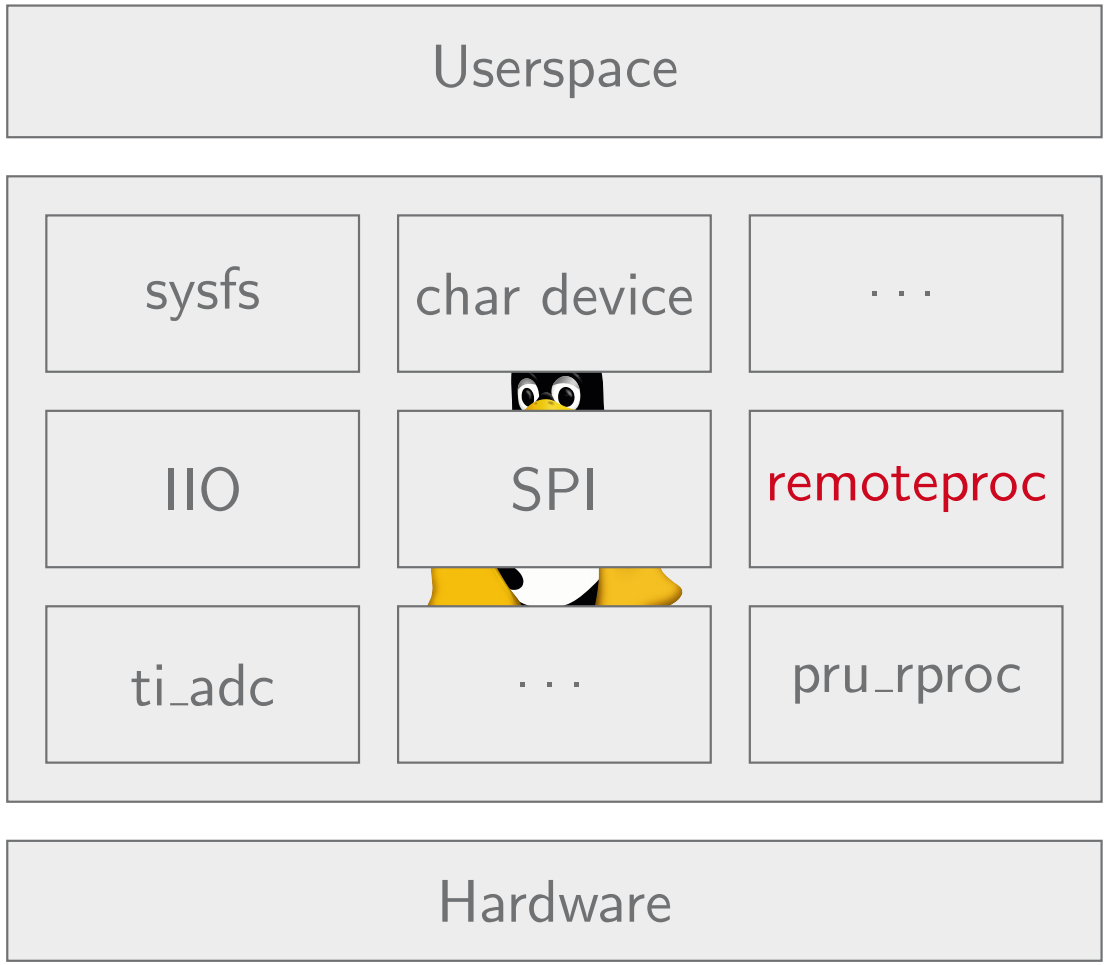


General Purpose Processor

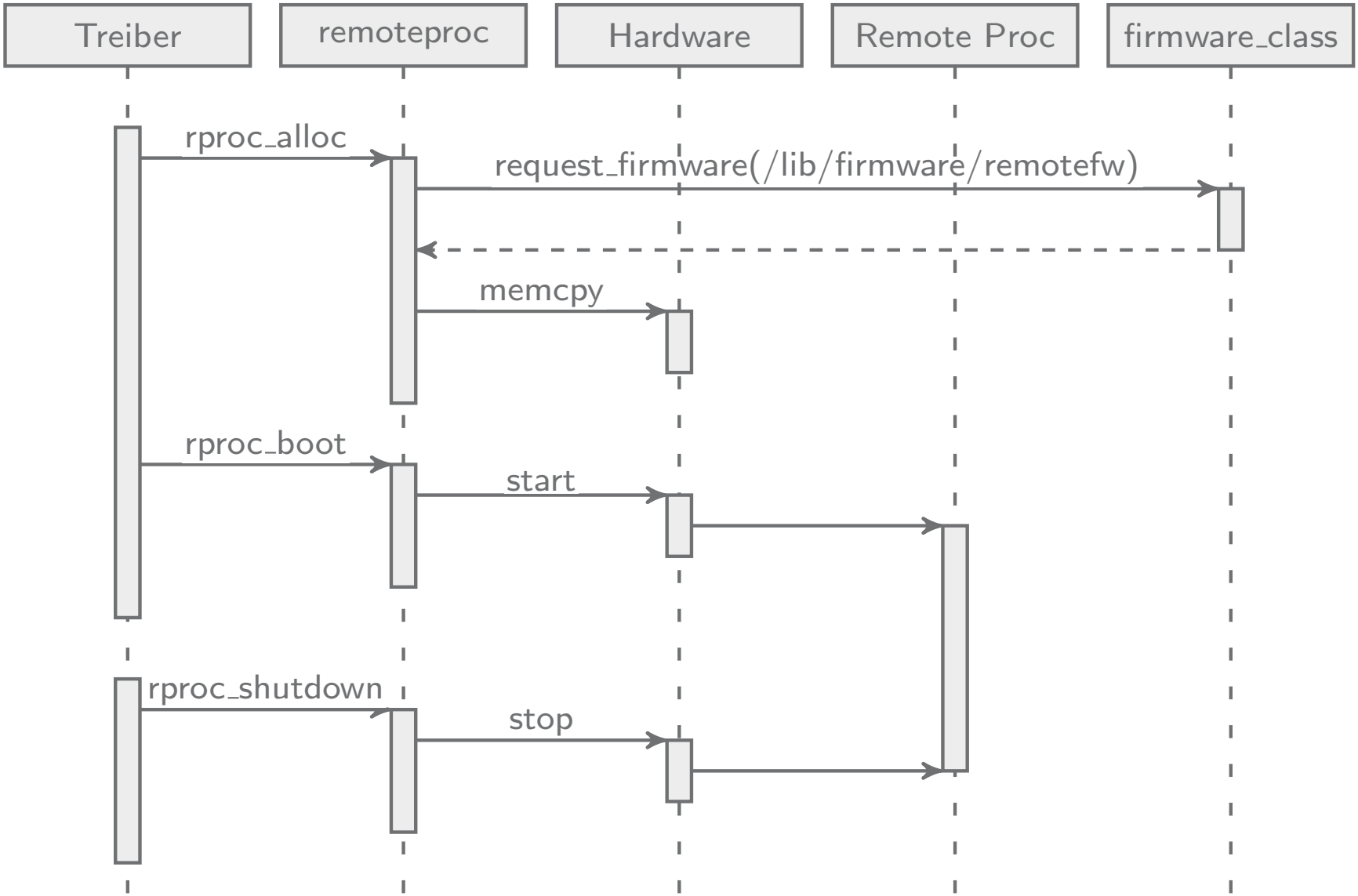
Remote Processor

AMP SoC

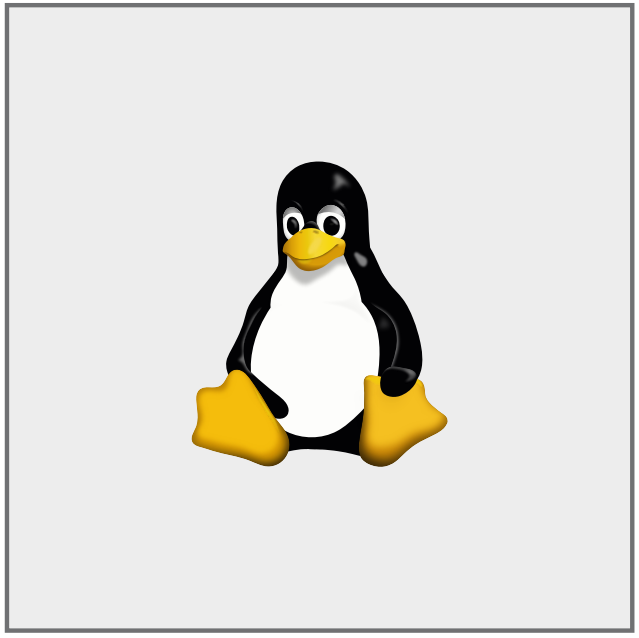

LINK-PP
LPJ0011BBNL
1251
A5A
5V

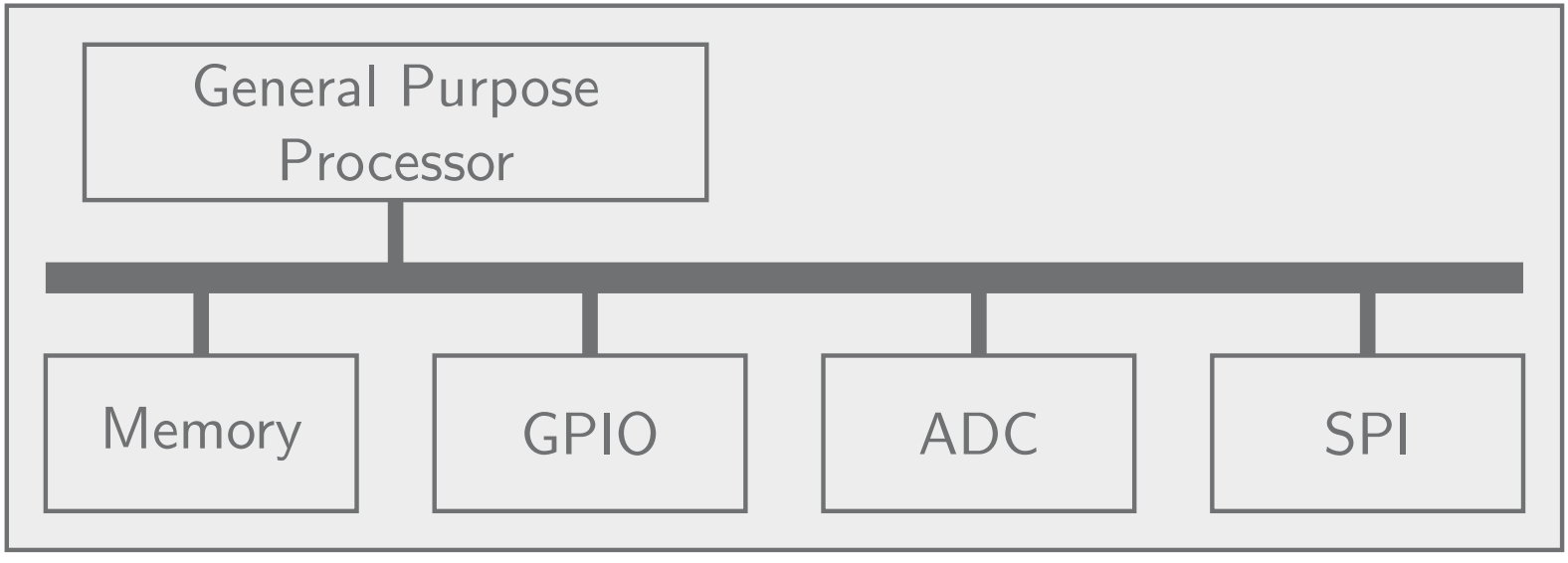

Userspace
sysfs
char device
...
IIO
SPI
remoteproc
ti_adc
...
pru_rproc
Hardware

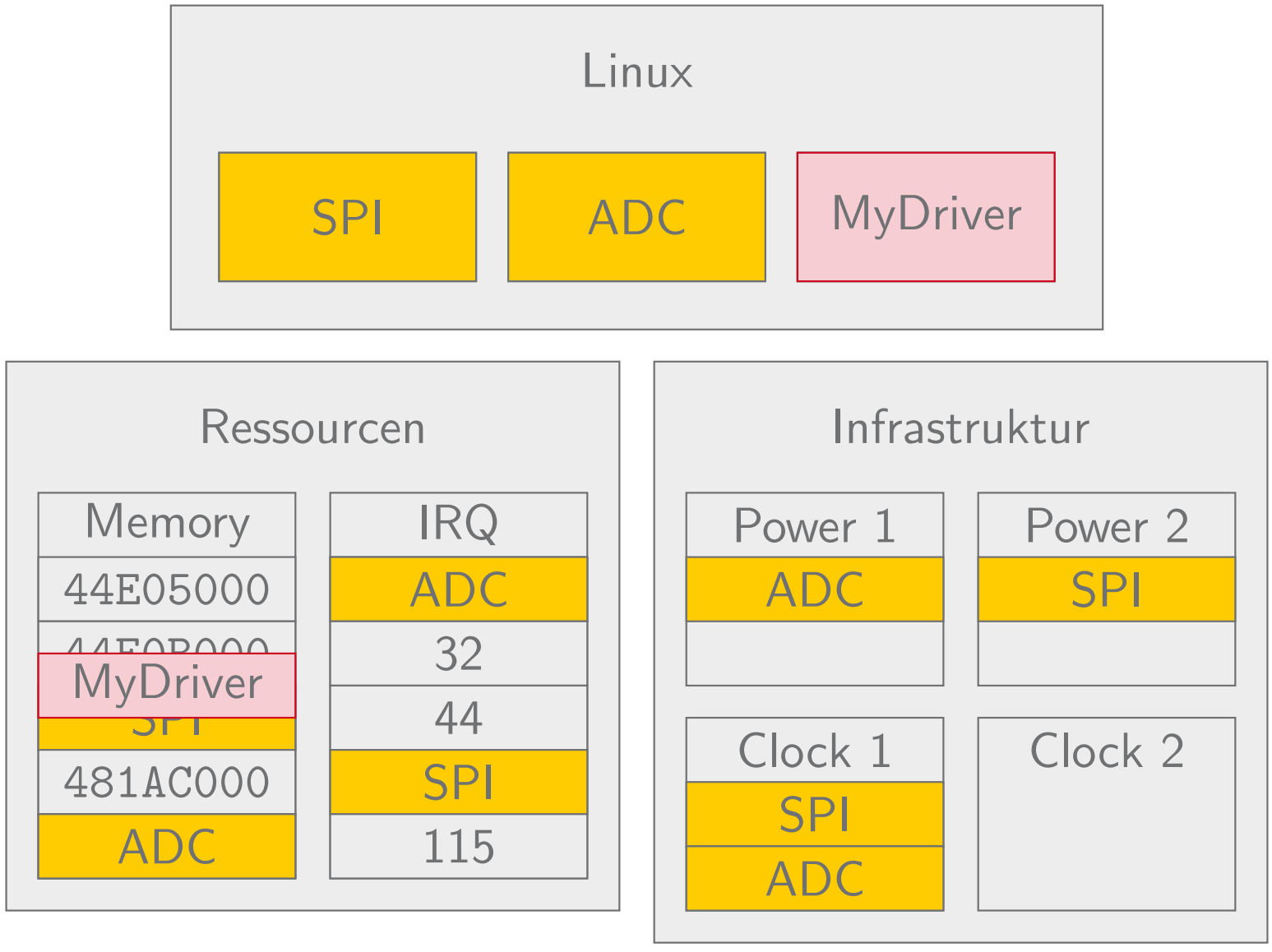
Bootstrapping

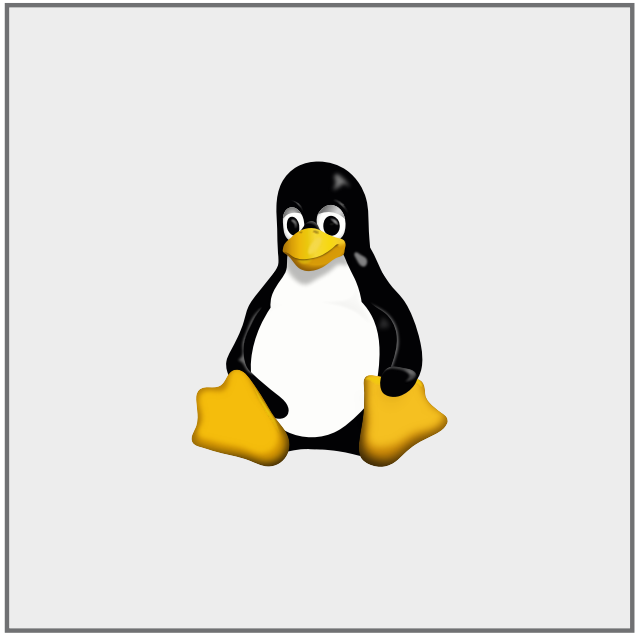

Treiber
remoteproc
Hardware
Remote Proc
firmware_class
rproc_alloc
request_firmware(/lib/firmware/remotefw)
memcpy
rproc_boot
start
rproc_shutdown
stop

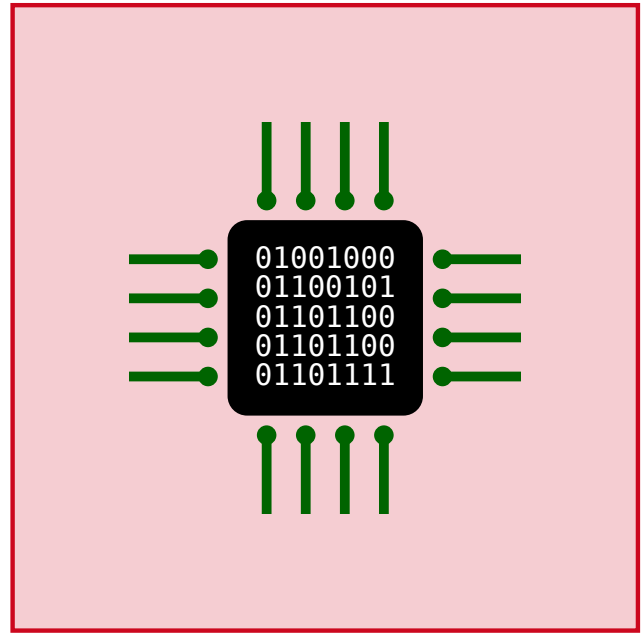
Ressourcenverwaltung

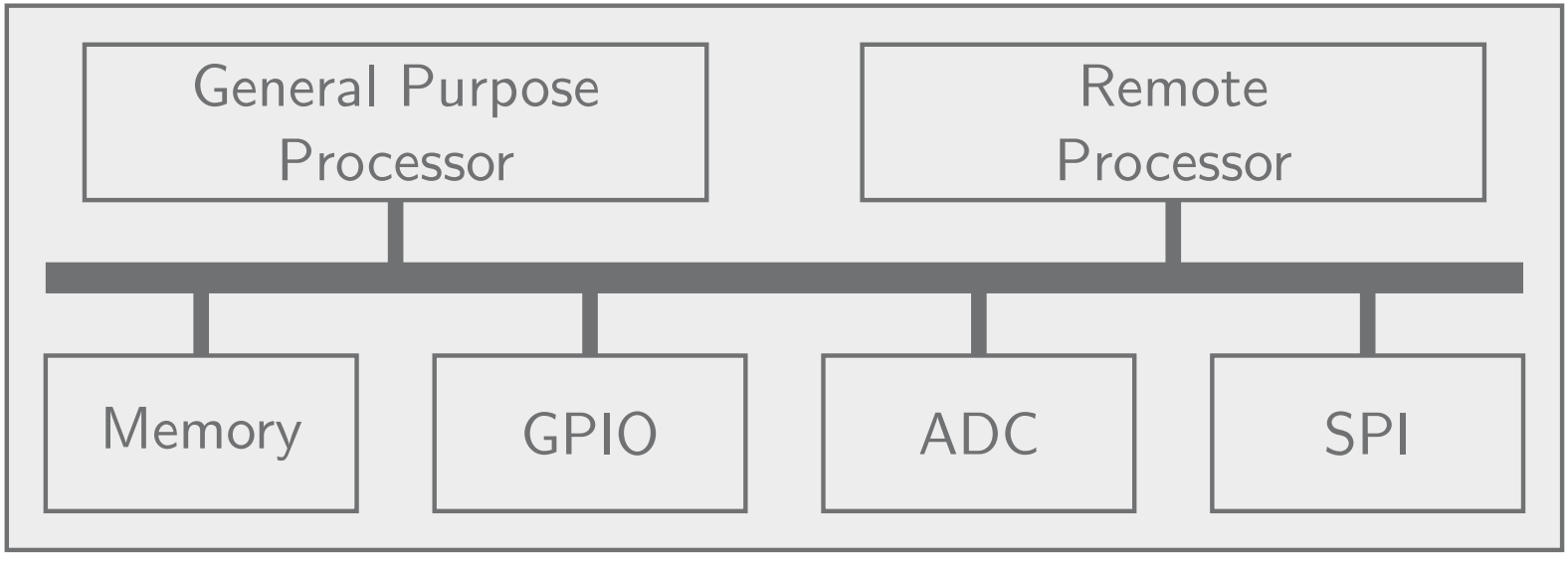


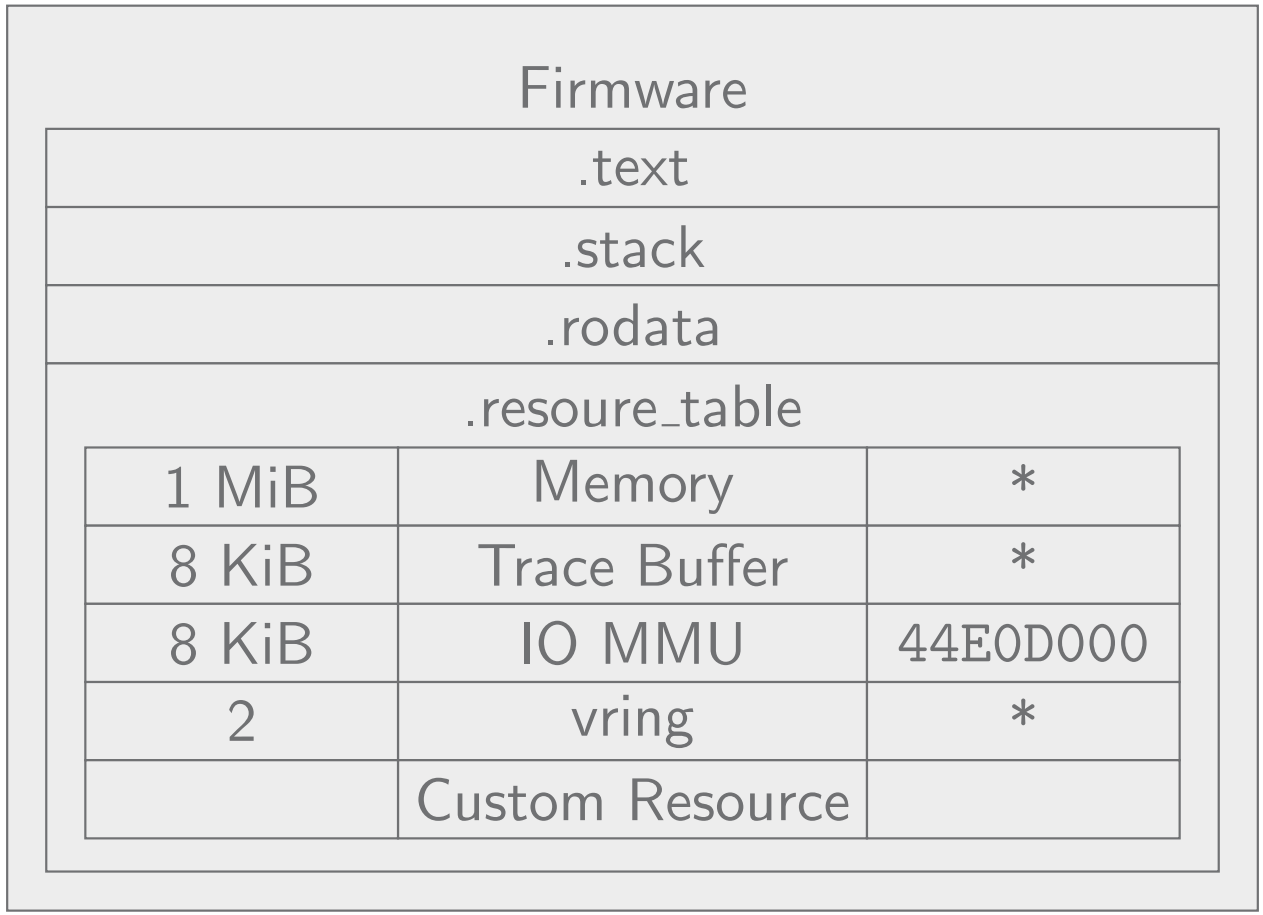

General Purpose Processor
Memory
GPIO
ADC
SPI


Linux
SPI
ADC
MyDriver
Ressourcen
Memory
44E05000
MyDriver
481AC000
ADC
IRQ
ADC
32
44
SPI
115
Infrastruktur
Power 1
ADC
Power 2
SPI
Clock 1
SPI
ADC
Clock 2

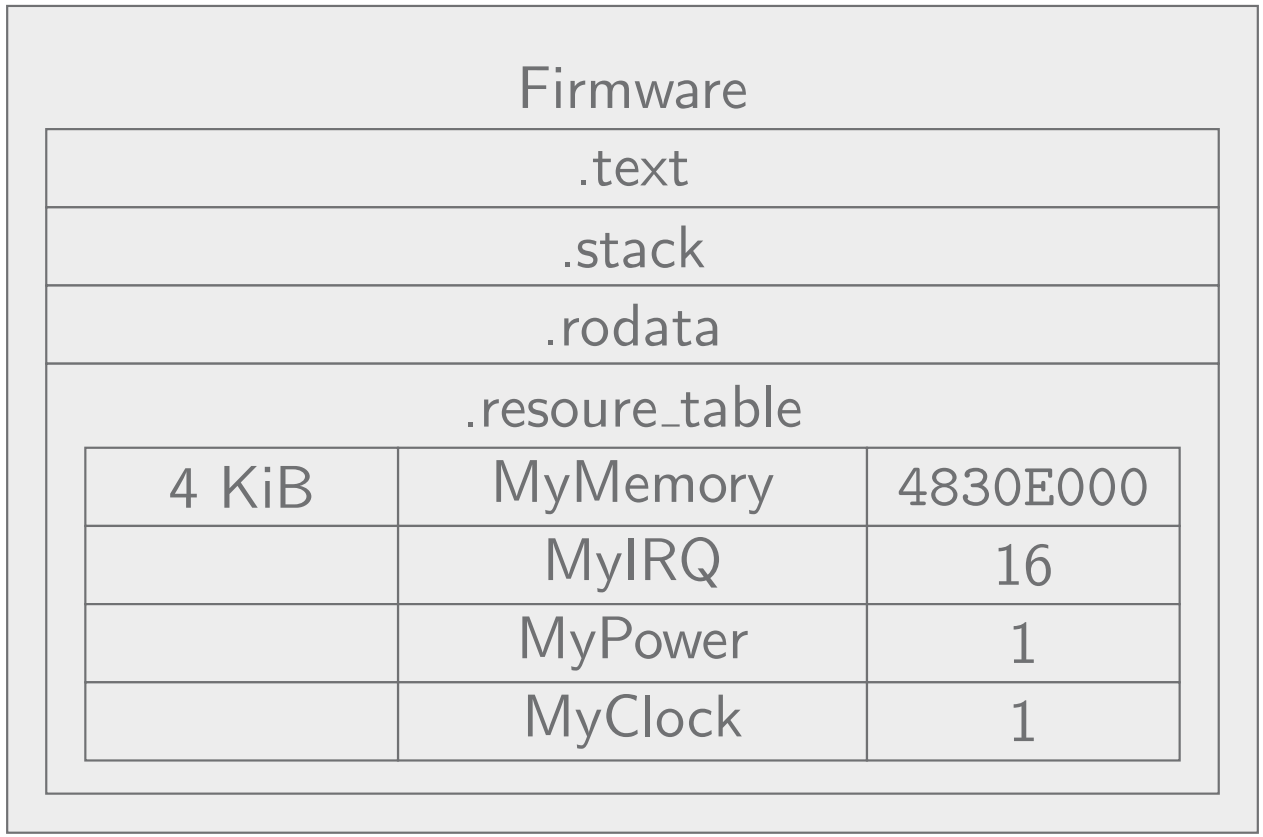


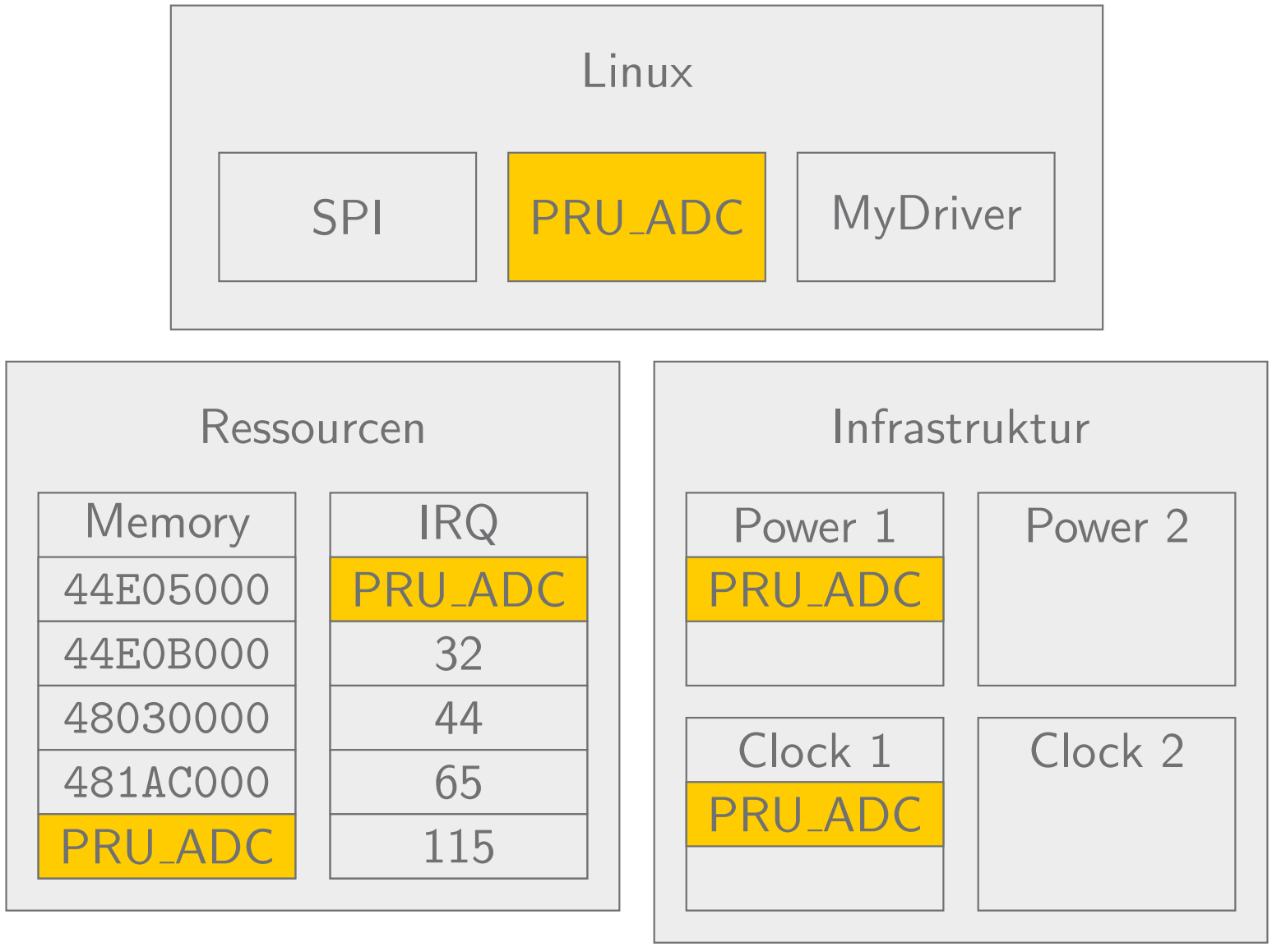

01001000
01100101
01101100
01101100
01101111


General Purpose Processor
Remote Processor
Memory
GPIO
ADC
SPI

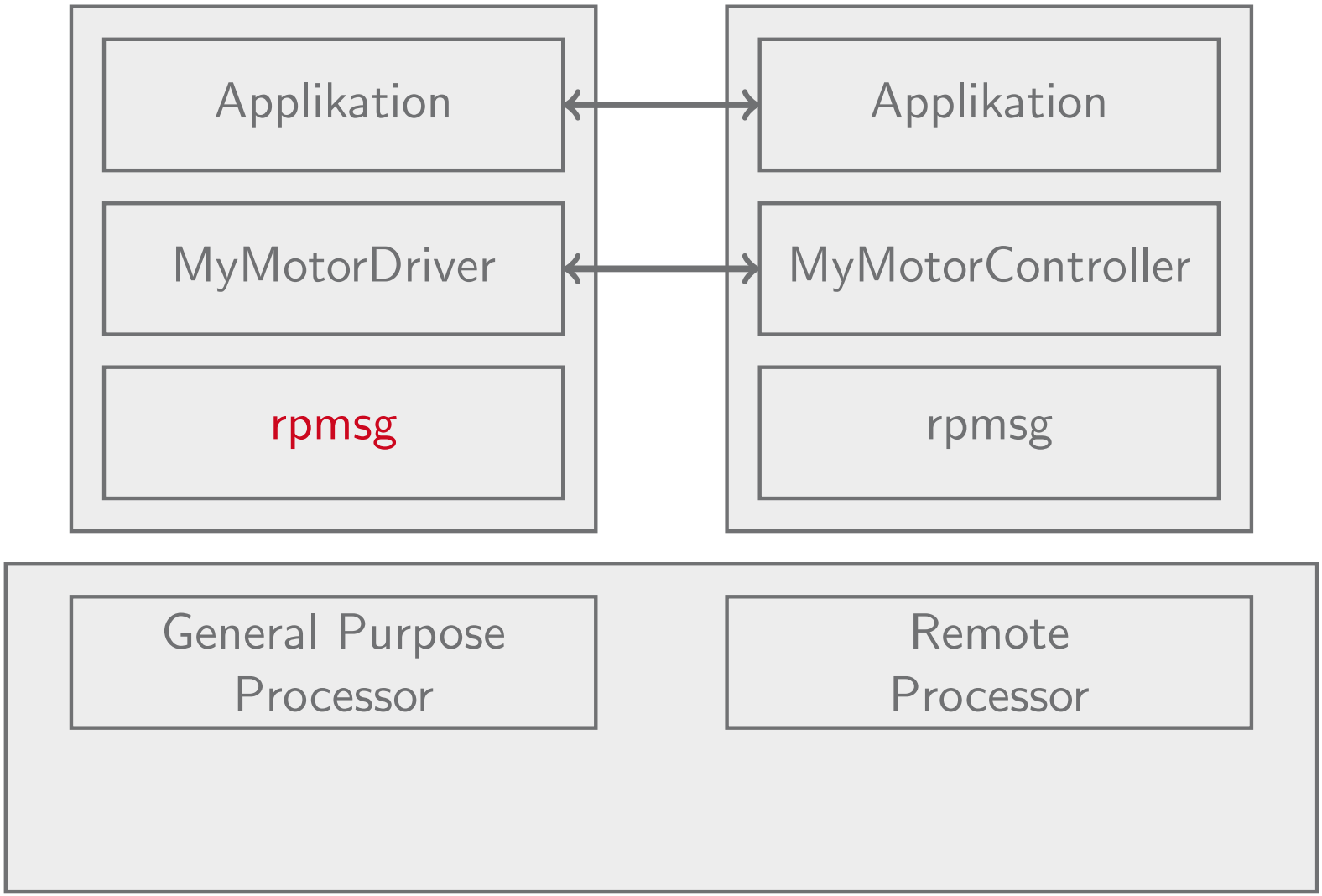

Firmware
.text
.stack
.rodata
.resoure_table
1 MiB
Memory
*
8 KiB
Trace Buffer
*
8 KiB
IO MMU
44E0D000
2
vring
*
Custom Resource

Workaround Ressourcen


Firmware
.text
.stack
.rodata
.resoure_table
4 KiB
MyMemory
4830E000
MyIRQ
16
MyPower
1
MyClock
1

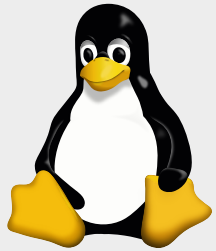

Linux
SPI
PRU_ADC
MyDriver
Ressourcen
Memory
IRQ
44E05000
PRU_ADC
44E0B000
32
48030000
44
481AC000
65
PRU_ADC
115
Infrastruktur
Power 1
PRU_ADC
Power 2
Clock 1
PRU_ADC
Clock 2

Kommunikation


Applikation
Applikation
MyMotorDriver
MyMotorController
rpmsg
rpmsg
General Purpose Processor
Remote Processor

Zusammenfassung

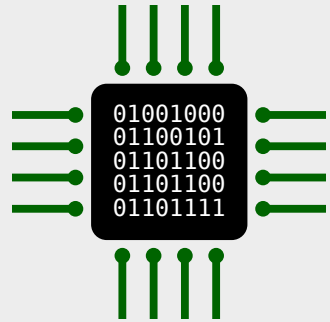
Firmware



remoteproc

rpmsg

resource table



rpmsg

General Purpose Processor

Remote Processor

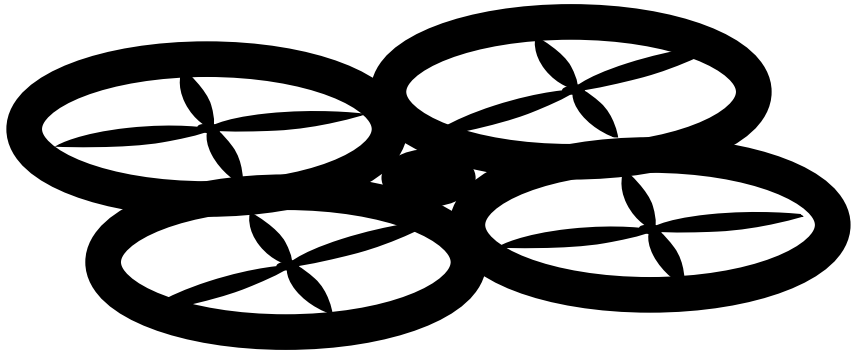
Asymmetrisches Multiprozessorsystem

Memory

GPIO

ADC

SPI

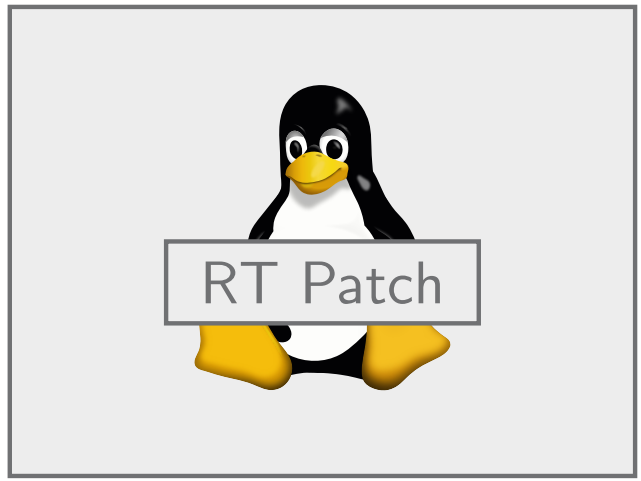


bbv

MAKING VISIONS WORK.

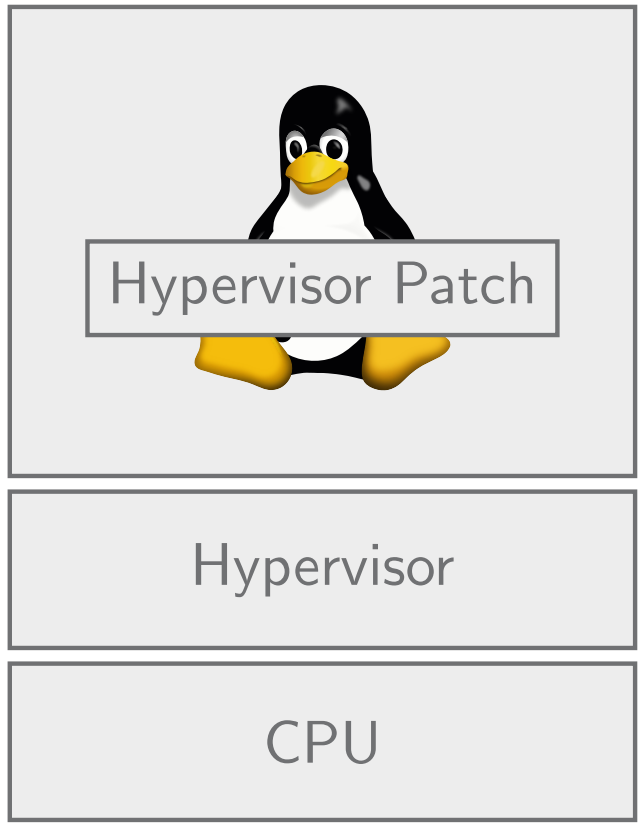
Appendix

Echtzeit unter Linux



CPU

Echtzeit unter Linux



Bildnachweis

Beaglebone Black - Top: CC-SA by Gareth Halfacree, 5
Embedded Software: CC-BY-SA by Urs Fässler, 4, 12, 18, 20
Multirotor UAV: CC-0 by Map2Map, 2, 21
Tux: CC-0 by Larry Ewing and The GIMP, 4, 6, 10, 12, 18, 20, 23, 24