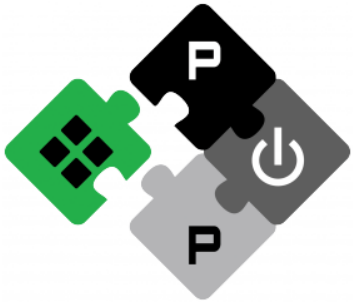


PULP PLATFORM
Open Source Hardware, the way it should be!

Bitcraze Workshop: AI-deck
Printed circuit board overview & GAP8 SDK

Lorenzo Lamberti, *Hanna Müller*, Vlad Niculescu, Manuele Rusci, Daniele Palossi


http://pulp-platform.org


@pulp_platform


https://www.youtube.com/pulp_platform

How to bring intelligence to nano-drones?

We have:

- Crazyflie
  - STM32F405
    - (Flight controller)
  - NRF51822
    - (radio)

We need:

- Information about surroundings
  - Camera
    (ULP, greyscale/RGB, QVGA)

- Processing power for image processing (parallel)
  - PULP

- One QVGA greyscale image ~ 80kB

→need more memory

- HyperMem Flash/RAM

Extra:

- WiFi Streaming

History – from the PULP-shield to the AI-deck

PULP-shield

Pluggable PCB:

- ~ 5 g – 30x28 mm
- PULP **GAP8** SoC
- DRAM/Flash
- QVGA ULP HiMax
- Open source

AI-deck

Pluggable PCB:

- ~ 8 g – 40x28 mm
- PULP **GAP8** SoC
- 8/64 MB DRAM/Flash
- QVGA ULP HiMax
- WiFi module

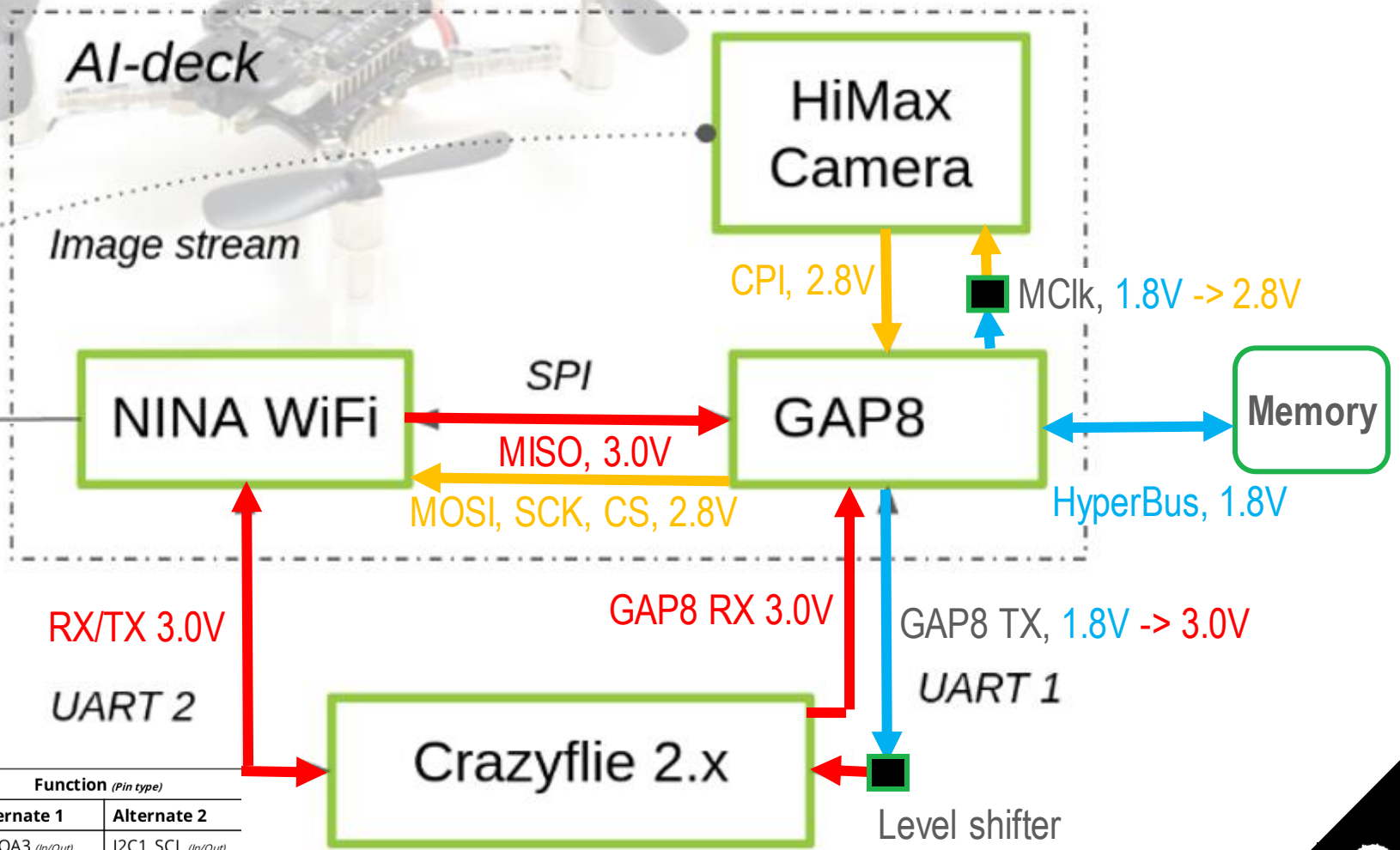
bitcraze

The AI-deck – logical connections

GAP8 has multiple voltage domains!

Why should I know this?

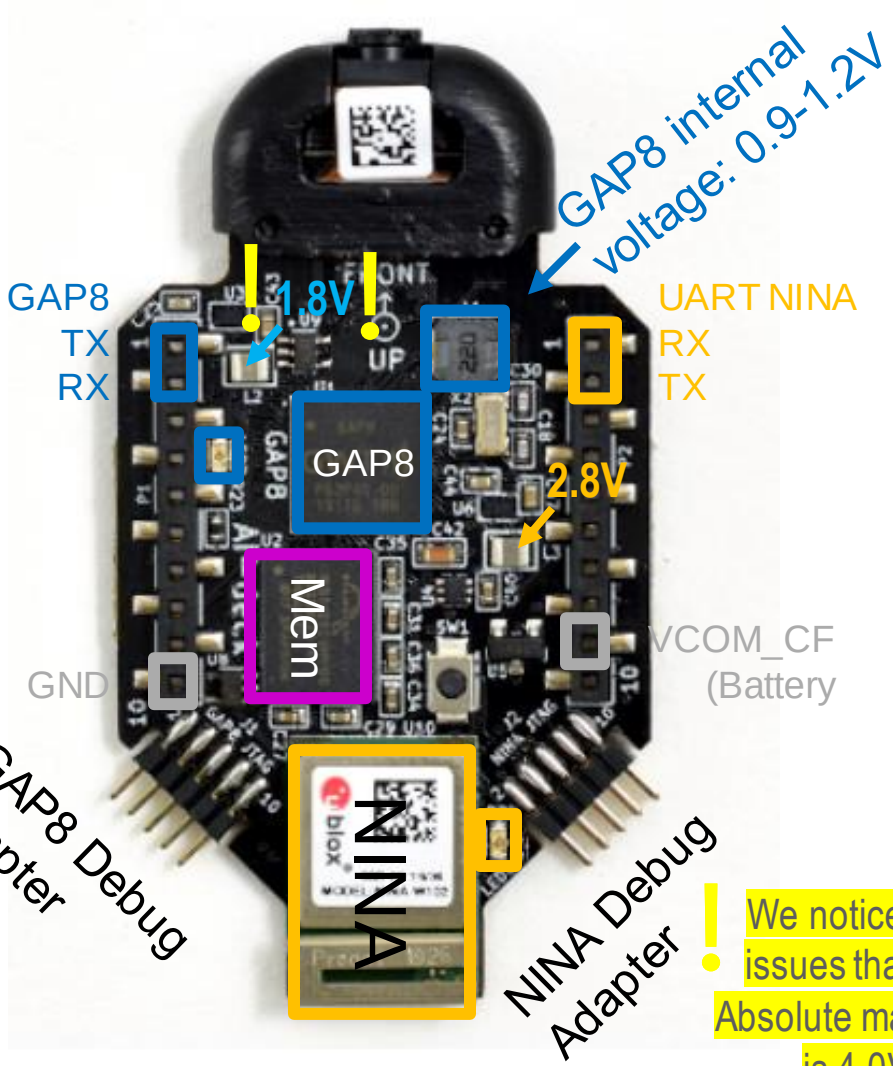
- For debugging (snooping busses)
- For fixing your deck if something broke
- For your own hardware extensions



Confusing detail:
SPIM_VDDIO voltage domain does NOT include the SPIM1 used here – it is in the CAM_VDDIO domain
CHECK DATASHEET!

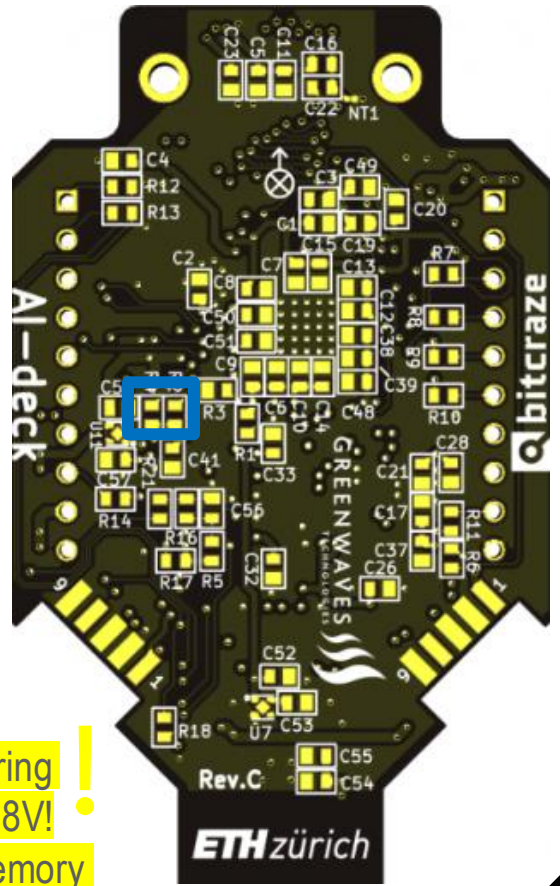
Position	Voltage Ref	Function (Pin type)		
		Default	Alternate 1	Alternate 2
B4	CAM_VDDIO	SPIM1_SCK (Out)	GPIOA3 (In/Out)	I2C1_SCL (In/Out)
A3	CAM_VDDIO	ORCA_TXSYNC (In)	GPIOA0 (In/Out)	SPIM1_CS0 (Out)
B2	CAM_VDDIO	ORCA_RXSYNC (In)	GPIOA1 (In/Out)	SPIM1_CS1 (Out)

The AI-deck



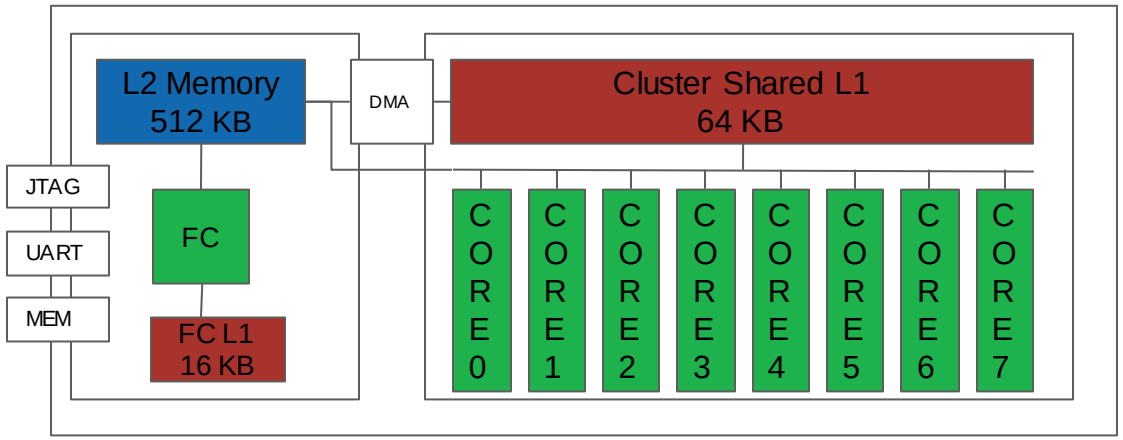
Capacitors – a lot of capacitors and some resistors

I2C GAP8/Camera
SCL SDA



! We noticed some decks have soldering issues that lead to 2.4V instead of 1.8V! !
Absolute maximum for the external memory is 4.0V, supply range up to 2.0V.

How to program GAP8? GAP-SDK!

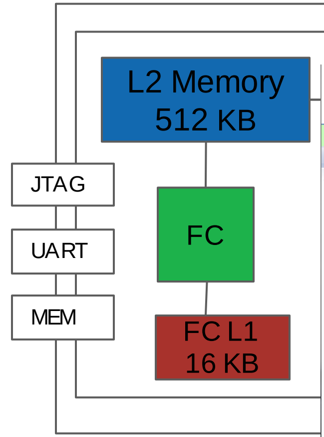


Example: to queue a buffer that receives camera samples:
In PMSIS BSP: static void pi_camera_capture _async()
Uses a function to queue a buffer that receives CPI samples:
In PMSIS API: static void pi_cpi_capture_async()
The OS is on top – you can define a callback task from your OS

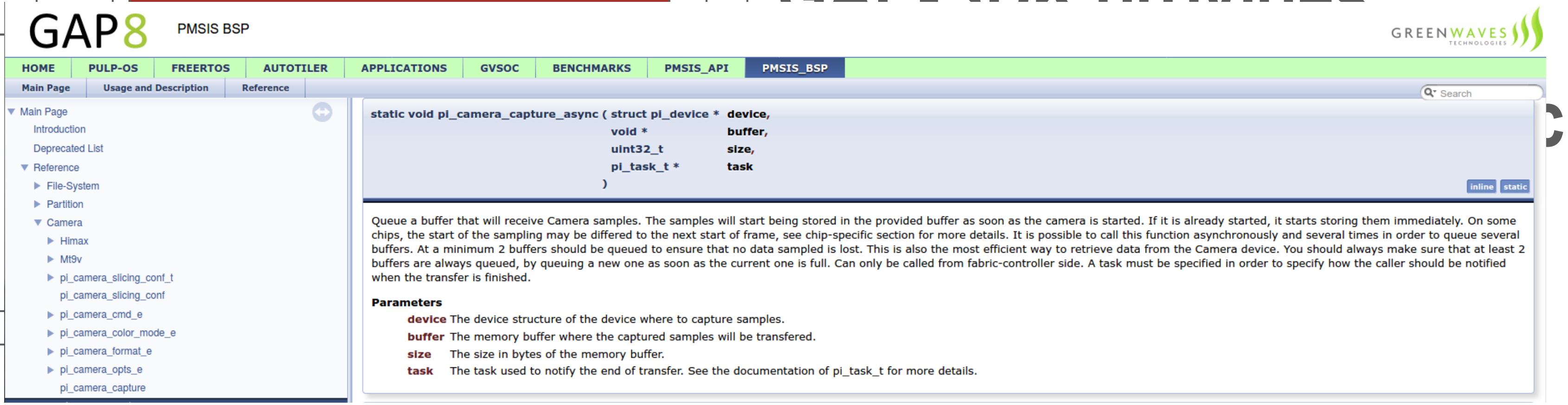
GAP-SDK provides:

- **GAP8 RISCV GNU toolchain:**
  - Program/control gap8
  - Use gdb
  - Program external HyperFlash
  - Virtual platform (gvsoc)
- **Operating Systems**
  - PulpOS
  - FreeRTOS
  - PMSIS API/BSP (common driver)

How to program GAP8?   GAP-SDK!



GAP-SDK provides:



chain:

https://github.com/GreenWaves-Technologies/gap_sdk

https://greenwaves-technologies.com/manuals/BUILD/HOME/html/index.html

The OS is on

This function is used to control and configure the Camera device. For each command, the arguments necessary are listed below:

CMD	Type of argument
CMD_ON	NULL
CMD_OFF	NULL
CMD_START	NULL
CMD_STOP	NULL

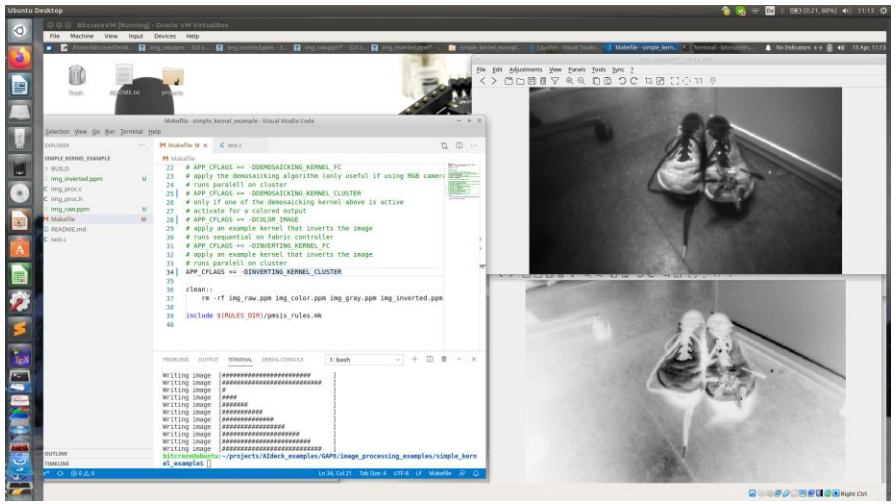
Generated on Tue Dec 1 2020 15:49:44 for by GreenWaves Technologies

- PMSIS API/BSP (common driver)

How to program GAP8?

Easiest way: Bitcraze VM!

- Gap-sdk is installed! Open a terminal and get started :)
- Also: All tools installed to compile for and flash the STM32 and nRF on the Crazyflie
  (Ubuntu, gnu-arm-none-eabi toolchain, python dependencies, KiCad, and many more)
- **Update your Crazyflie 2.x** to the most recent firmware before trying to program GAP8!



Important: in the VM you need to use docker!
Some commands are preconfigured in the .bashrc file
Just typing "make clean all run" like on a native install will not work. Type "gap_run" instead