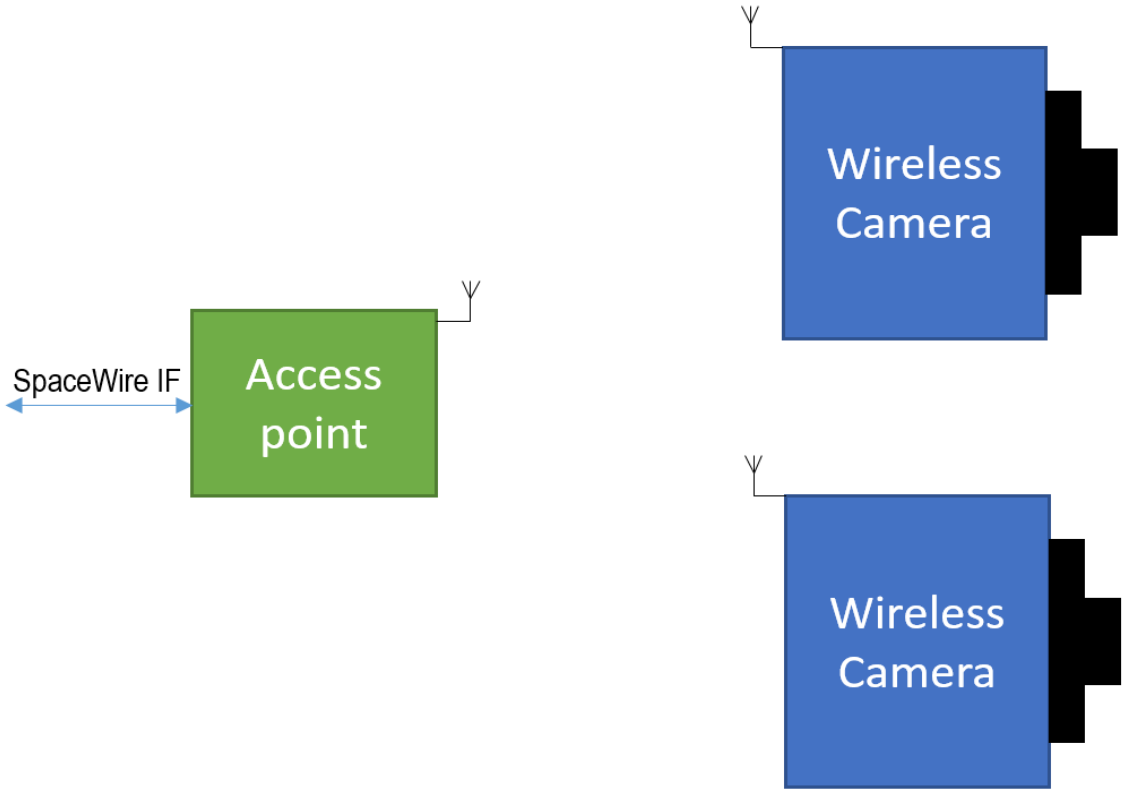
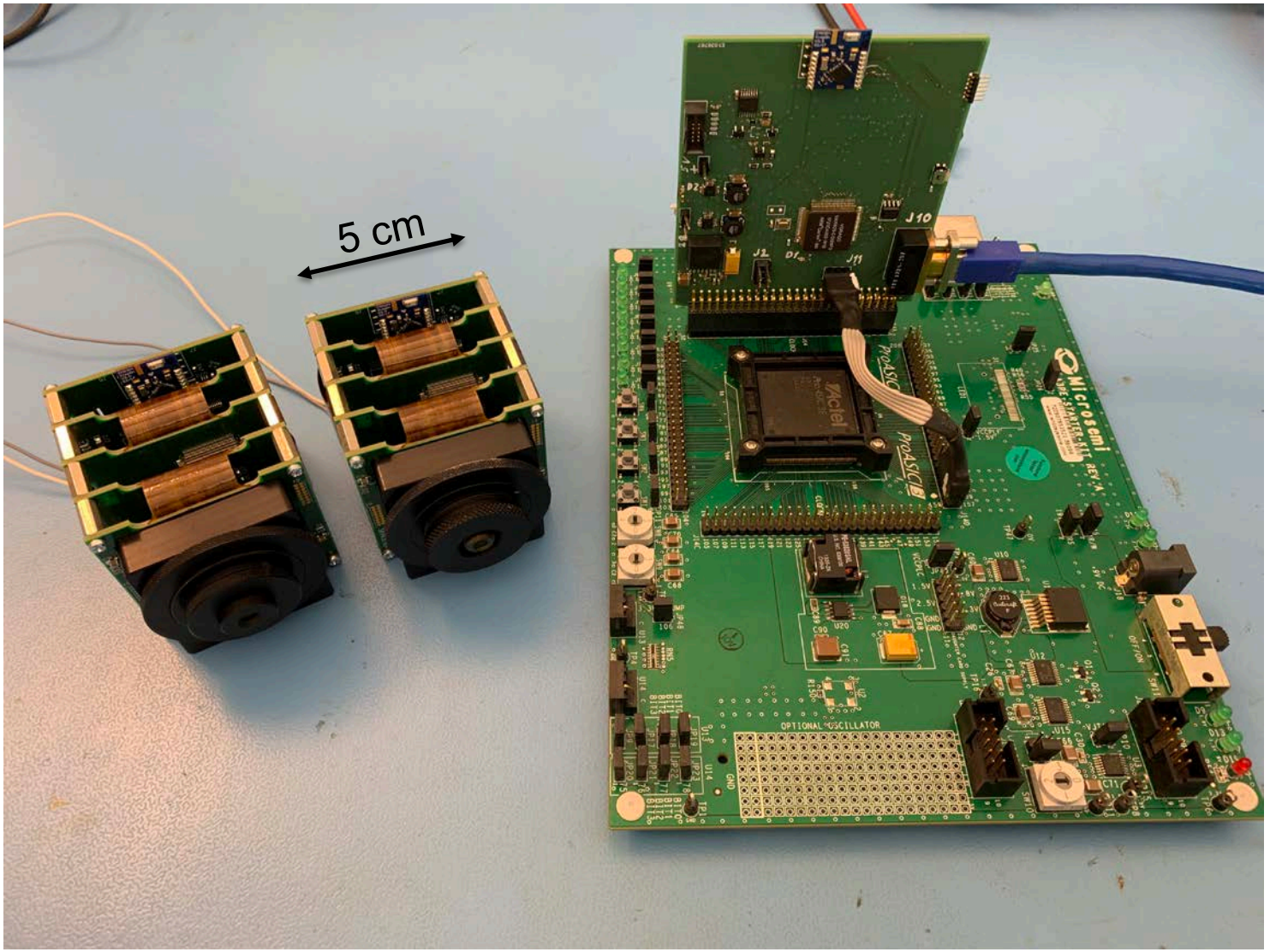
Low Energy Wireless Imaging System (LEWIS)

Mitko Tanevski

The LEWIS hardware components



The LEWIS hardware components



Presentation Outline

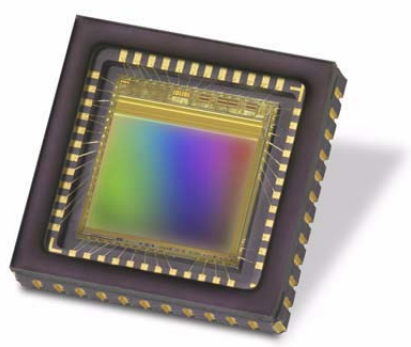
- Architecture and Key Component Choices
  - Image Sensor Choice
  - RF Module Choice
  - MCU Choice
- Wireless Camera Design
- Wireless Access Point Design
- Final System and Demo
- Conclusion

Architecture choice – Integration Strategy

- Wireless Communication module as separate HW
- Tight Integration with Camera / WAP

Image sensor choice

- Future-proof? Space qualified? (roadmap)
- (Relatively): Low-Power, high resolution, small size



e2v EV76C661
1280x1024 pixels
200 mW
Peak QE > 65%
12.7 x 12.7 mm
10 bits per pixel
Max. 60 fps

Images: teledyne-e2v

MCU choice

- Low-Power and small size
- Space Qualified (radiation hardened/tolerant)

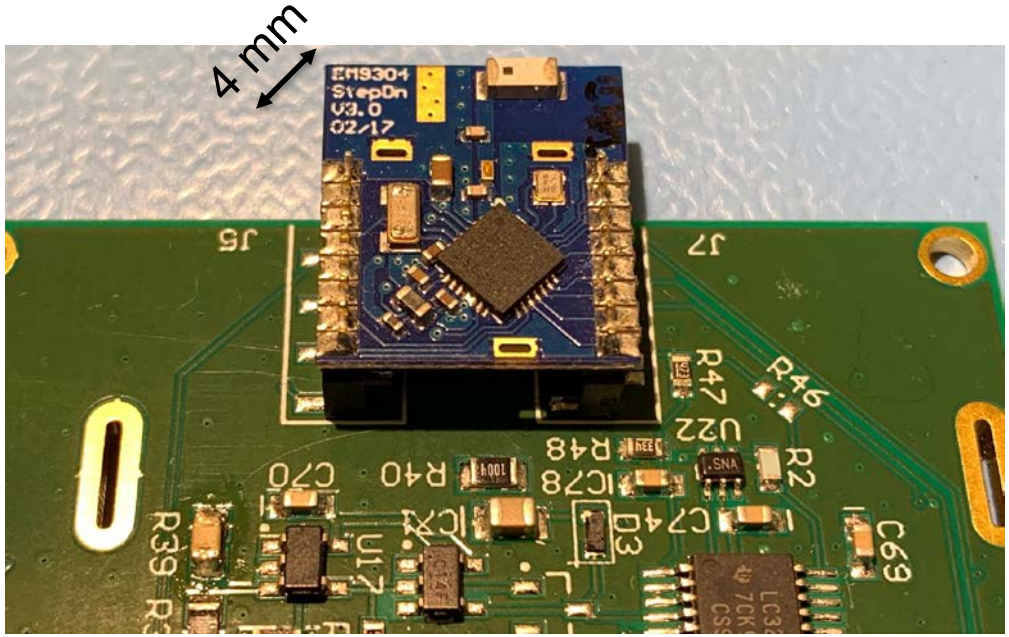
Vorago Technologies
VA10820
50MHz MCU
32KB data, 128KB program
>300K rad (Si)
-55 to +125 ℃
Current at max. activity:
105mA (~160 mW)

RF Module choice

- Is it already space qualified?
- How can we use it in a space application anyways?
- Can we hope to obtain access to the IP?
- What if we ignore total-dose and focus on latch-up immunity only?

RF Module choice

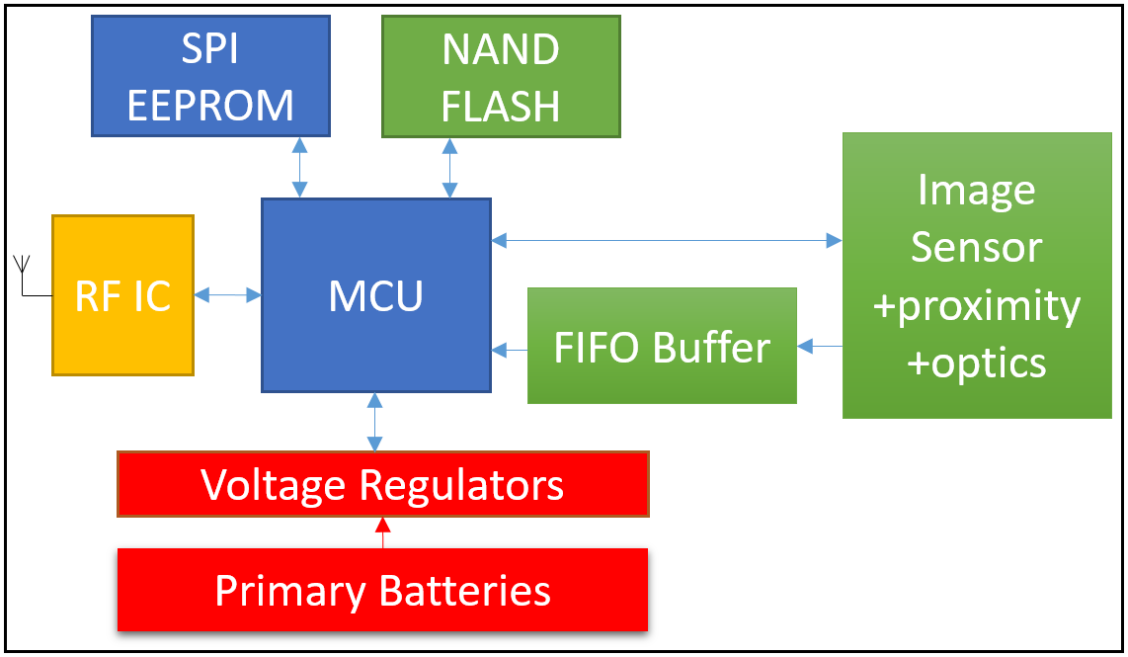
- Low-Power and small size
- Access to the platform through the manufacturer



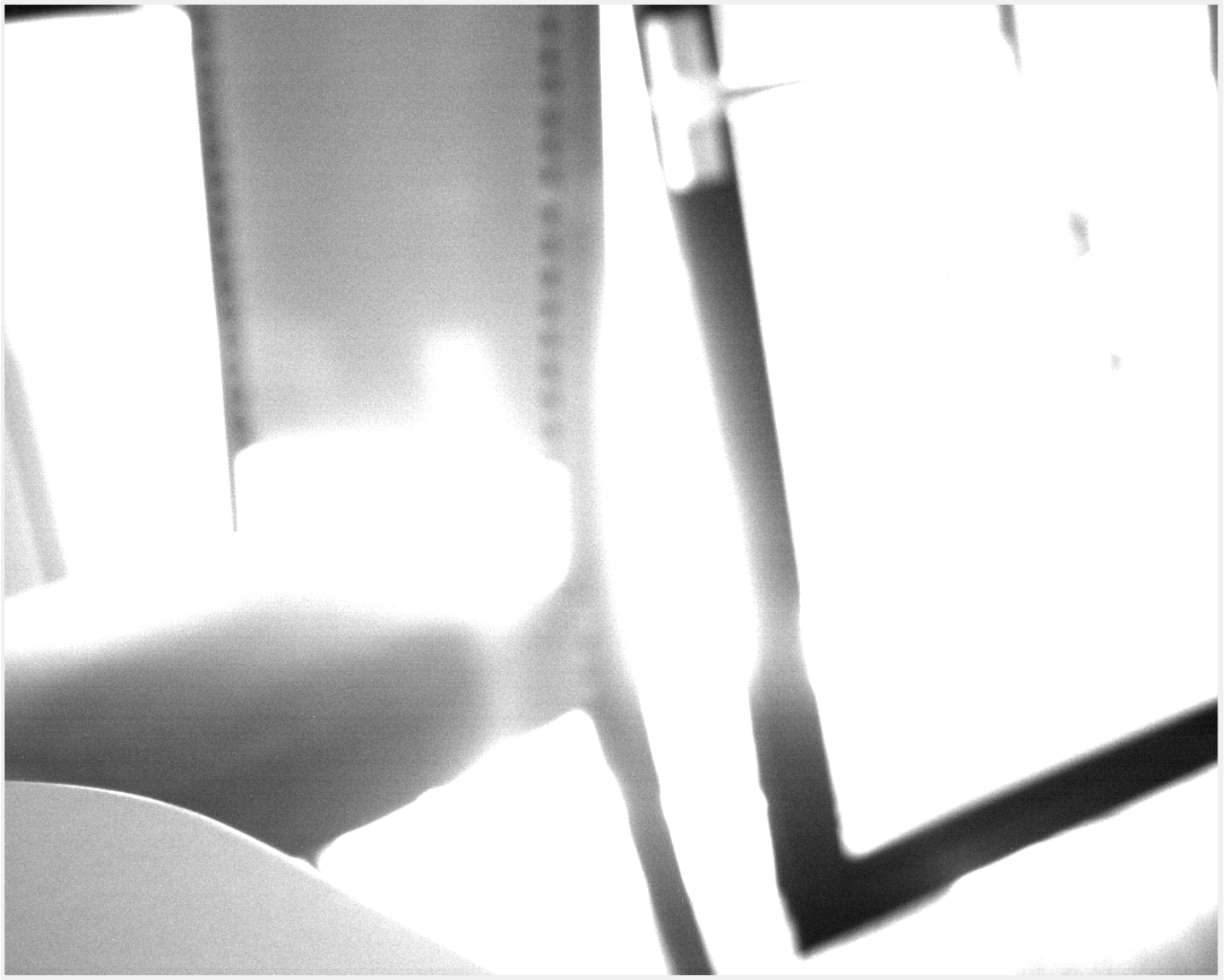
EM Microelectornics
EM9403 - Module
SoC: 32bit MCU @24MHz
(136kB ROM incl. LL and stack, 128kB OTP, 48kB instr. RAM 28kB data RAM)
Bluetooth 5.0 LE
3.0 mA peak receiver current
1 µA connected sleep mode

- Latch-up protection circuit added

Wireless Camera Design



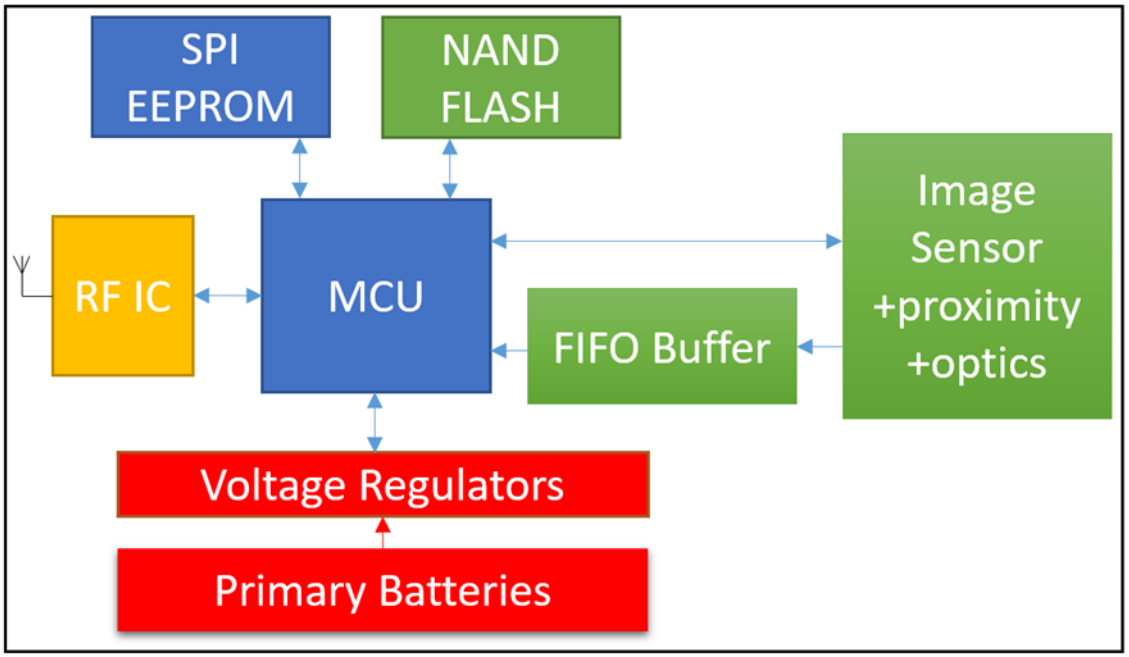
Camera First Light (Aug 2017)



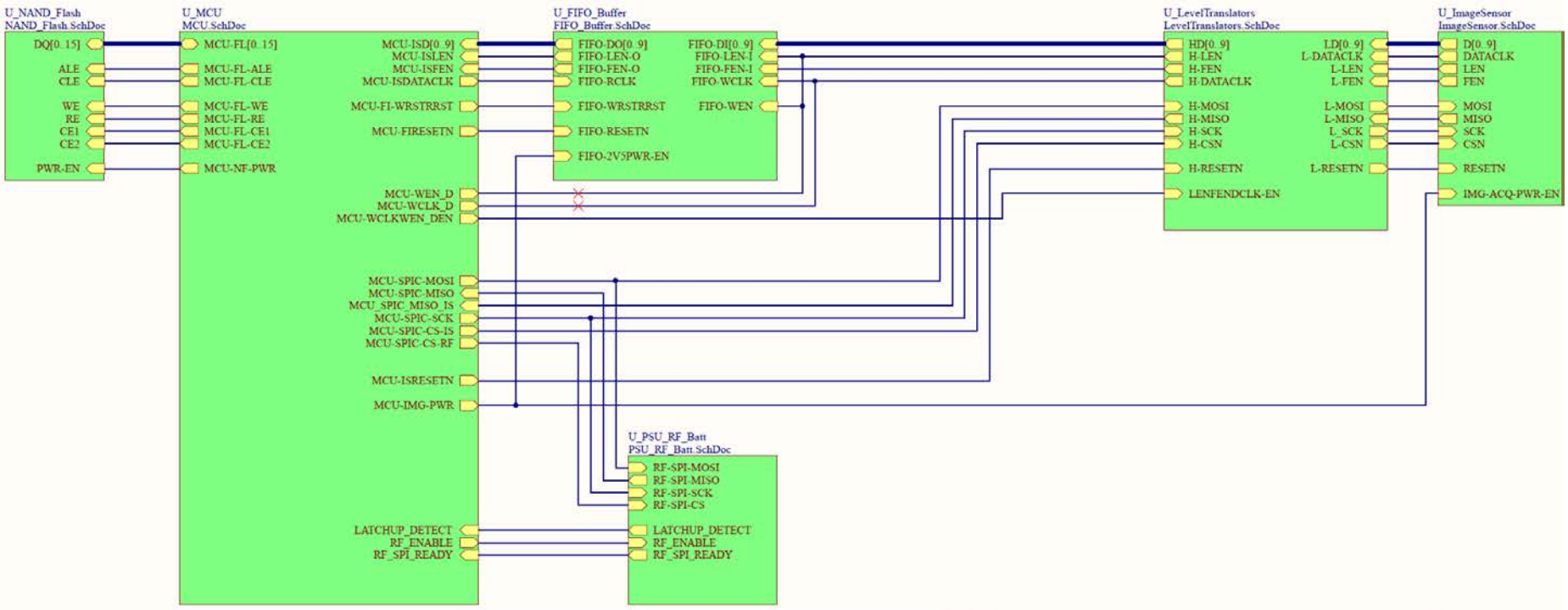
One of the first colour photos

Wireless Camera Design

- Standby mode: only RF module powered and advertising (pre launch)
- Active mode: MCU Powered and master

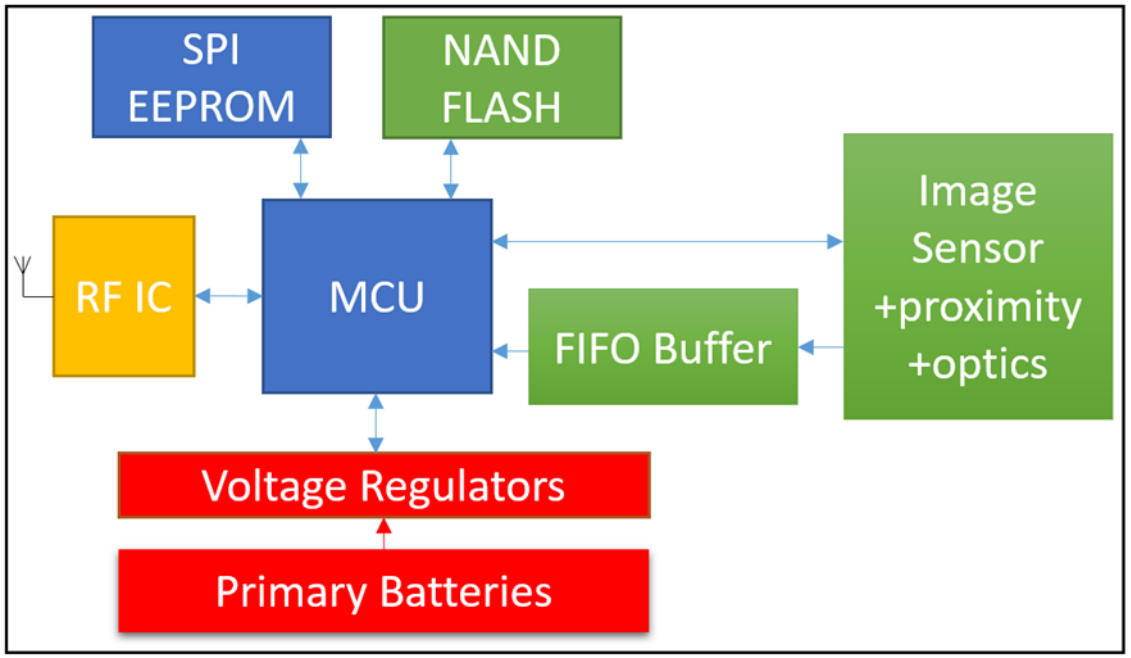


Wireless Camera Design



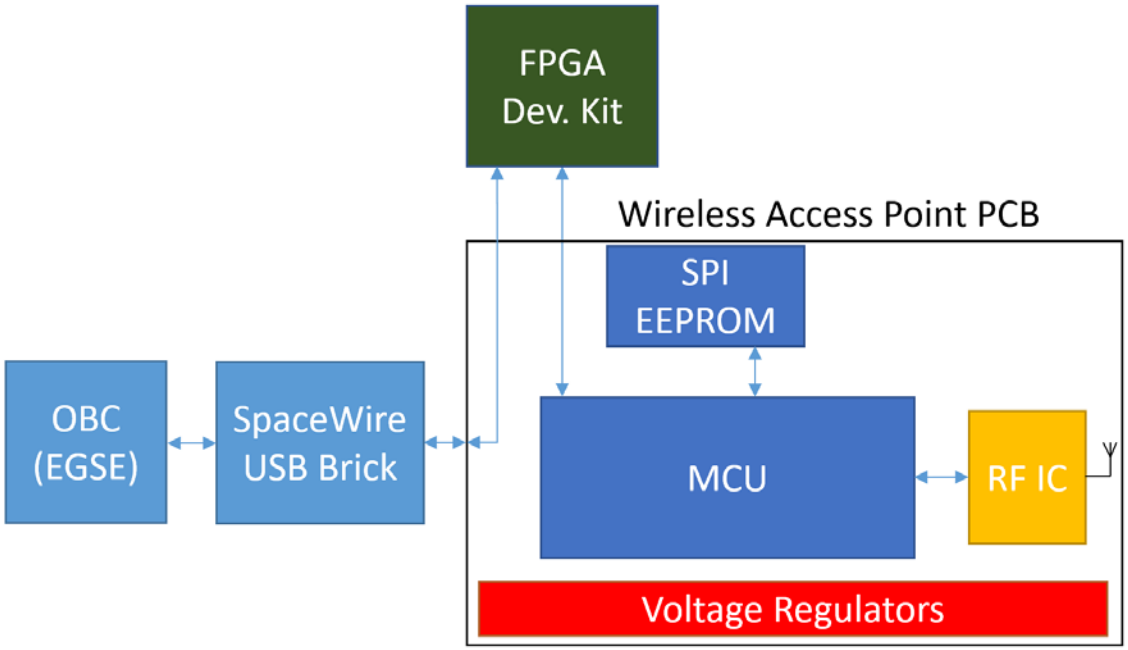
Wireless Camera Standby Mode

- Each camera is advertising and connectable
- MCU and all other components are not powered
- Once enabled the RF module powers the MCU (one way latch) and switches to HCI

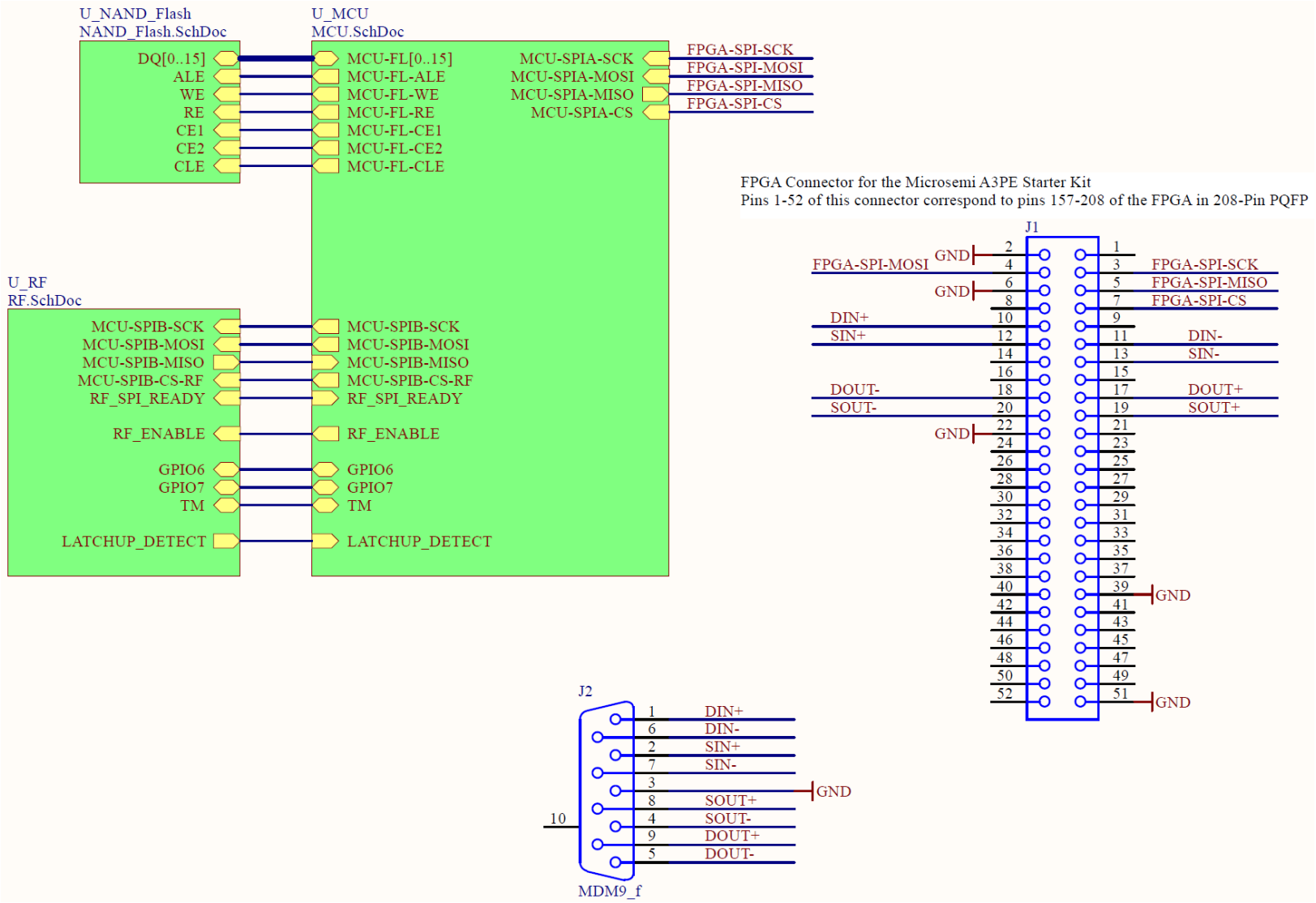


Wireless Access Point Design

- SpaceWire RMAP to SPI bridge and the same MCU and RF Module as the wireless camera



Wireless Access Point Design



LEWIS Test results

- Wireless camera max. power consumption

  0.78 W (155 mA @5V; Image acquisition)

- Wireless camera standby power consumption

  10.2 mW (2.03 mA @5V; 49 mAh/24h)

- Access point MCU PCB max. power consumption

  0.24 W (8.51 mA @28V)

LEWIS Test results

- Range Test – Image transfer up to 7m LoS

- Wireless communication protocol test
- Access point functionality test

Summary of HW and SW developed

- Wireless camera in flex-rigid
- Wireless Camera Software/Firmware
  - High level communication protocol
  - Bluetooth ACL driver (HCI + onboard MCU for the standby)
  - Image sensor driver
  - FIFO Frame Buffer Driver
  - Flash memory driver and simple file system
- WAP MCU PCB
- WAP Software/Firmware
  - Communication
  - SpaceWire RMAP to SPI bridge in FPGA
  - MCU driver for SpaceWire RMAP to SPI bridge
  - Bluetooth ACL driver (Similar as for the camera)
- EGSE console application

One of the recent photos

Conclusion

Questions?

Batteries

- Saft LO35SX
- 2/3 C (L=35.9mm, Ø=25.9mm)
- Nominal Capacity 2.2 Ah
- Nominal Voltage 2.8 V
- Operating Temp. -60°C +70°C
- Typical weight 30 g
- Max. continuous current 2A
- Open circuit volt. 3V