DESY MMC SOLUTIONS

New Features and more Modularity for an optimal AMC Management

Sven Stubbe, Patrick Huesmann, Carsten Dülsen
Hamburg, 8th December, 2022

MicroTCA TECHNOLOGY LAB

DESY.

DESY MMC SOLUTIONS

New Features and more Modularity for an optimal AMC Management

MicroTCA TECHNOLOGY LAB

Overview

MMC Mailbox

- Implementation in MMC Firmware
- Implementation in SoC Firmware

UART Forwarding to IPMB-L

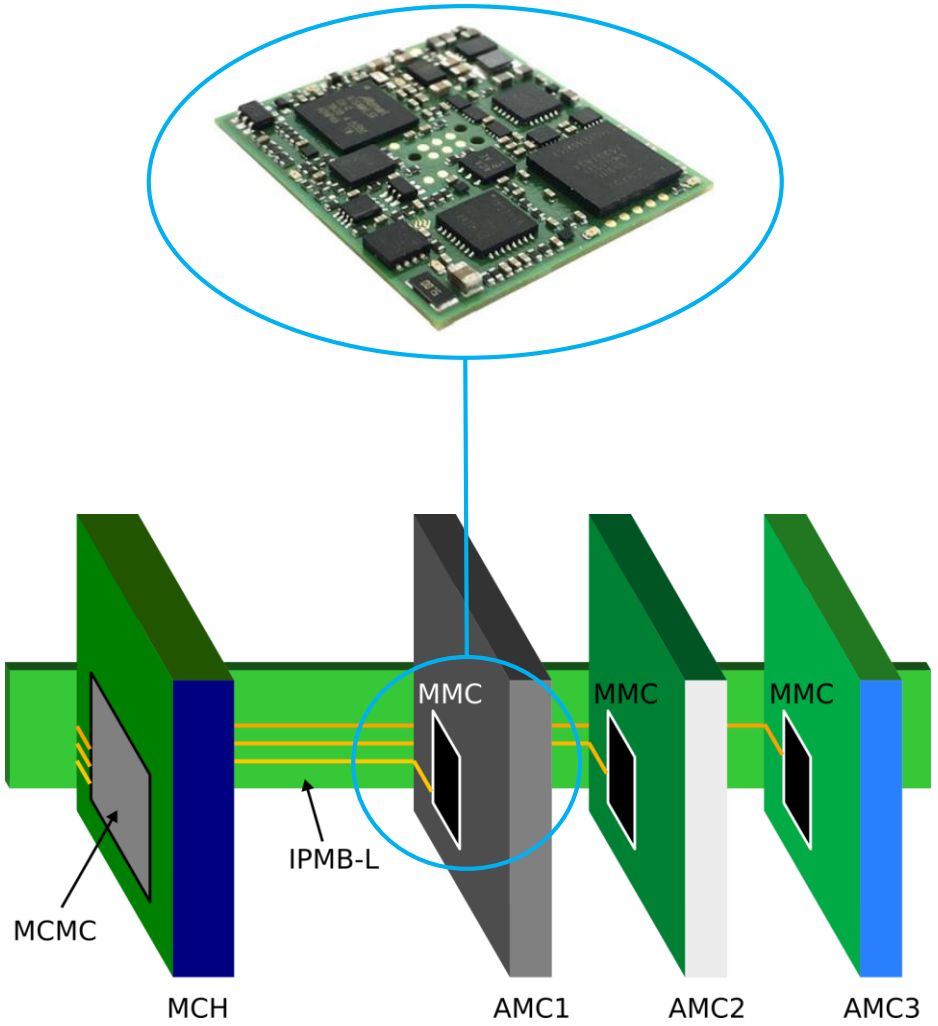
Conclusion

Overview

Management in MicroTCA

- System perspective
  - MicroTCA Carrier Management Controller (MCMC)
  - Enhanced Module Management Controllers (eMMCs) (interfaced via IPMB-0: IPMB-A, IPMB-B)
  - Module Management Controller (MMC) (interfaced via IPMB-L)
- AMC perspective
  - IPMI parsing / message generation
  - Provide FRU information
  - Event handling: sensors, thresholds, alerts
  - RTM control
  - Payload management (e.g. FPGAs/SoCs, FMCs)
- DMMC-STAMP: drop-in solution for AMC MMC
  - Manufactured and provided by DESY

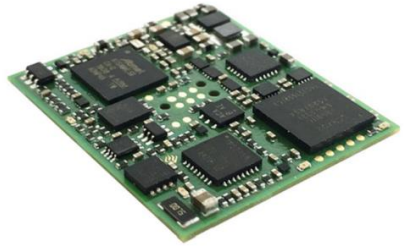
DMMC-STAMP System on a Module



Overview

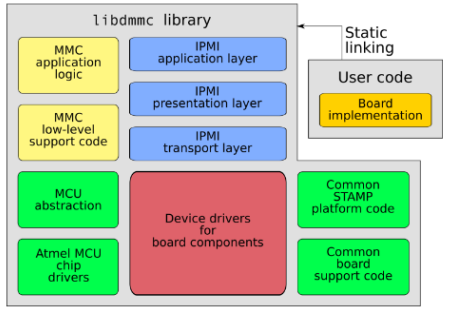
DESY MMC Solutions

- DMMC-STAMP SoM
  - Pre-programmed firmware
  - Tiny: 25.5 x 29.5 x 2.3 mm
- DMMC-SDK
  - MMC firmware customization
  - DESY MMC Software Library
  - Example implementations (e.g. DAMC-FMC2ZUP)
- Open Source Tools and Templates
  - AMC and RTM Altium Designer Templates
  - mmcterm: serial over IPMB
  - bin2hpm: convert bitfiles for IPMI upgrade
  - frugy: generating FRUs
  - IPMI tools (e.g. in-system firmware update)

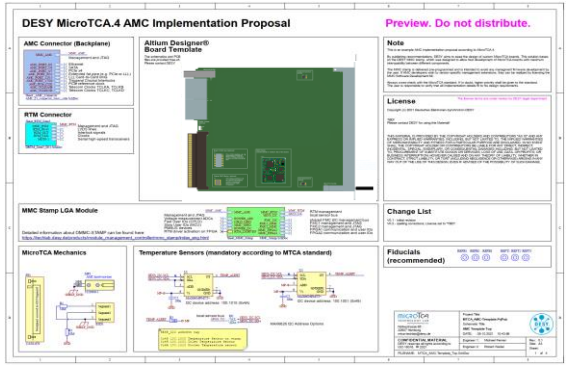


DMMC-STAMP

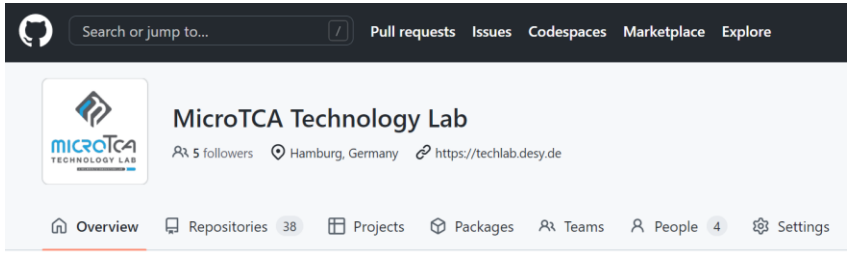
DMMC-STAMP-BoB



DMMC-SDK



Altium Design Templates (incl. DMMC-STAMP)

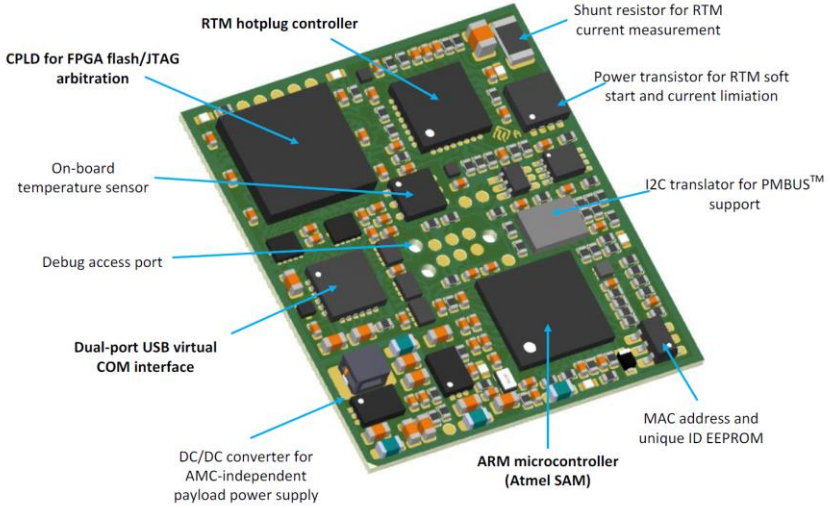


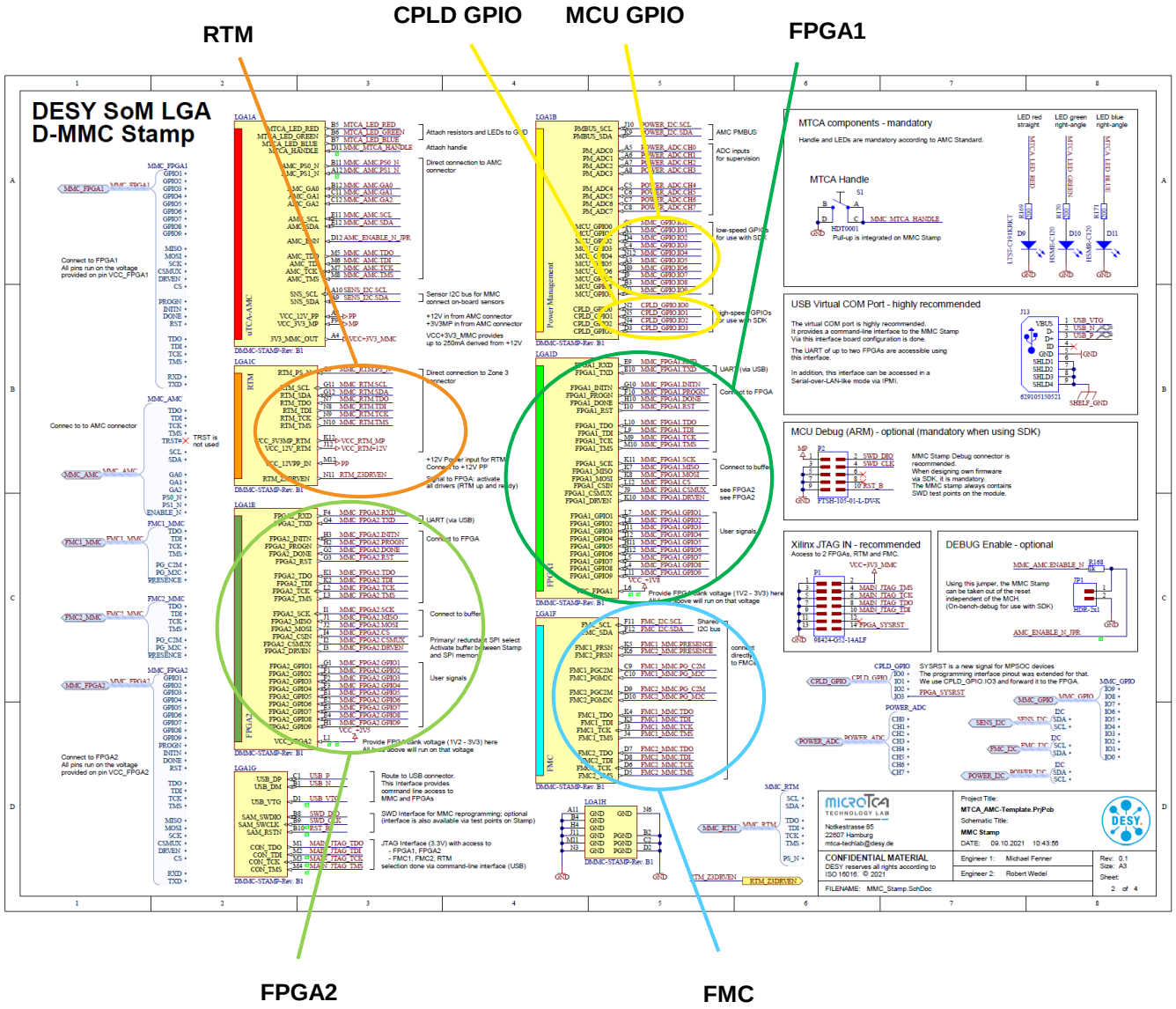
Useful tools on GitHub

Overview

DMMC-STAMP System on a Module

- Programmable building blocks:
  - ARM Microcontroller
  - Lattice CPLD
- Features for payload SoC interfacing by using customized firmware

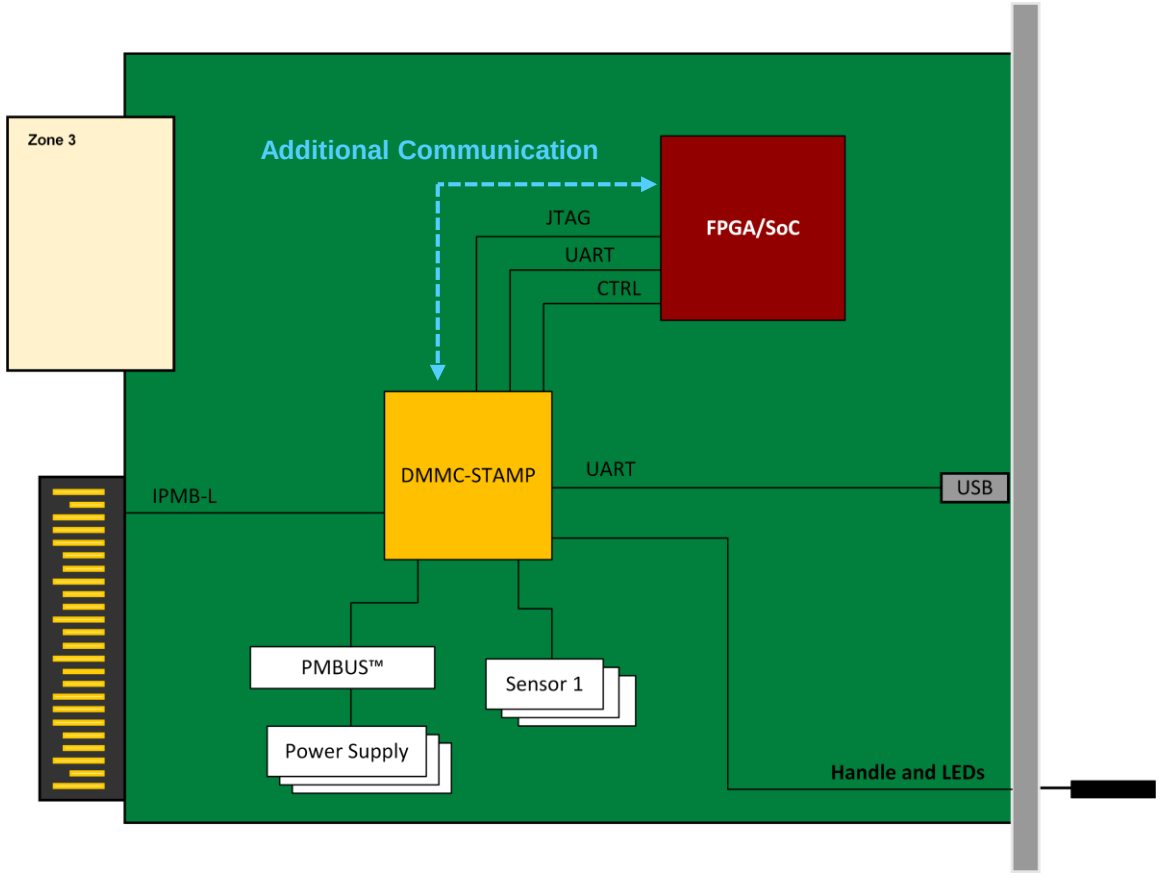




MMC Mailbox

Information Exchange between SoC OS and MMC

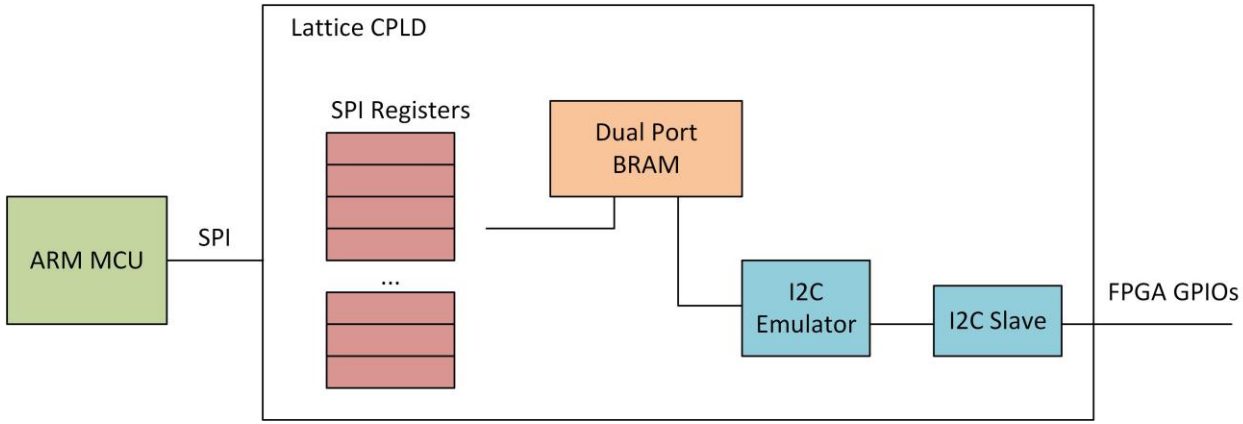
- Communication channel between AMC Management and SoC Processing System (Application)
  - Monitor system health information
  - Use on-board sensor data in application (e.g. for ADC/DAC calibration)
  - Use DMMC-STAMP unique ID as MAC address
  - Use connected FRU data in application
  - Application shutdown before turning off the payload power
  - User specific functionality
  - {…}



MMC Mailbox

Implementation on DMMC-STAMP Side

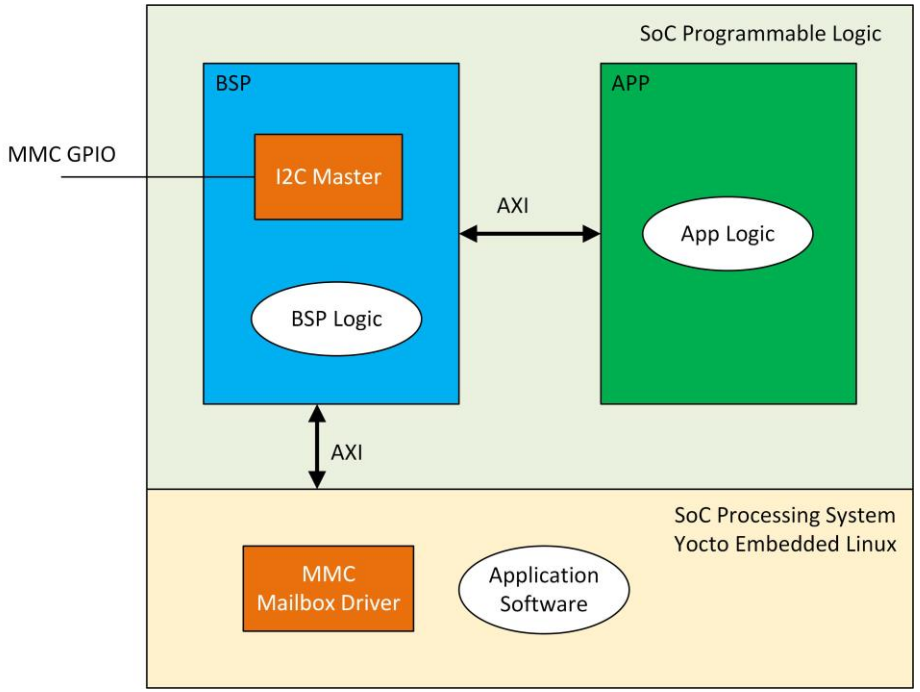
- Introduce 2-KB CPLD BRAM as „MMC Mailbox“
  - Access from MCU via SPI register space
  - Access from SoC via I2C
  - Defined register space
- EEPROM Emulation
  - Interface the CPLD BRAM
  - Emulate a Microchip 24C02 EEPROM
- Define a locking mechanism to avoid a competing register access
  - Registerflag
- Add software functionality to DMMC-STAMP MCU
  - Continuous upgrade of mmc information to mailbox
  - Handling of payload shutdown sequence



MMC Mailbox

Implementation on SoC Side

- Add I2C master to PL BSP section
- Modify device tree to support the „mmcmailbox“ driver
- Add mailbox driver and mailbox software to meta-techlab-bsp layer
  - Read MMC information from mailbox on request
  - Provide high-level API to be interfaced by user application
  - Poll mailbox register to get noticed about a Hot-Swap handle event




```
22
23  &iic_axi_iic_mmc {
24    compatible = "xlnx,axi-iic-2.0", "xlnx,xps-iic-2.00.a";
25    clock-names = "s_axi_aclk";
26    clocks = <&zynqmp_clk 71>;
27
28    mmcmailbox@2a {
29        compatible = "desy,mmcmailbox";
30        reg = <0x2a>;
31    };
32  };
```

MMC Mailbox

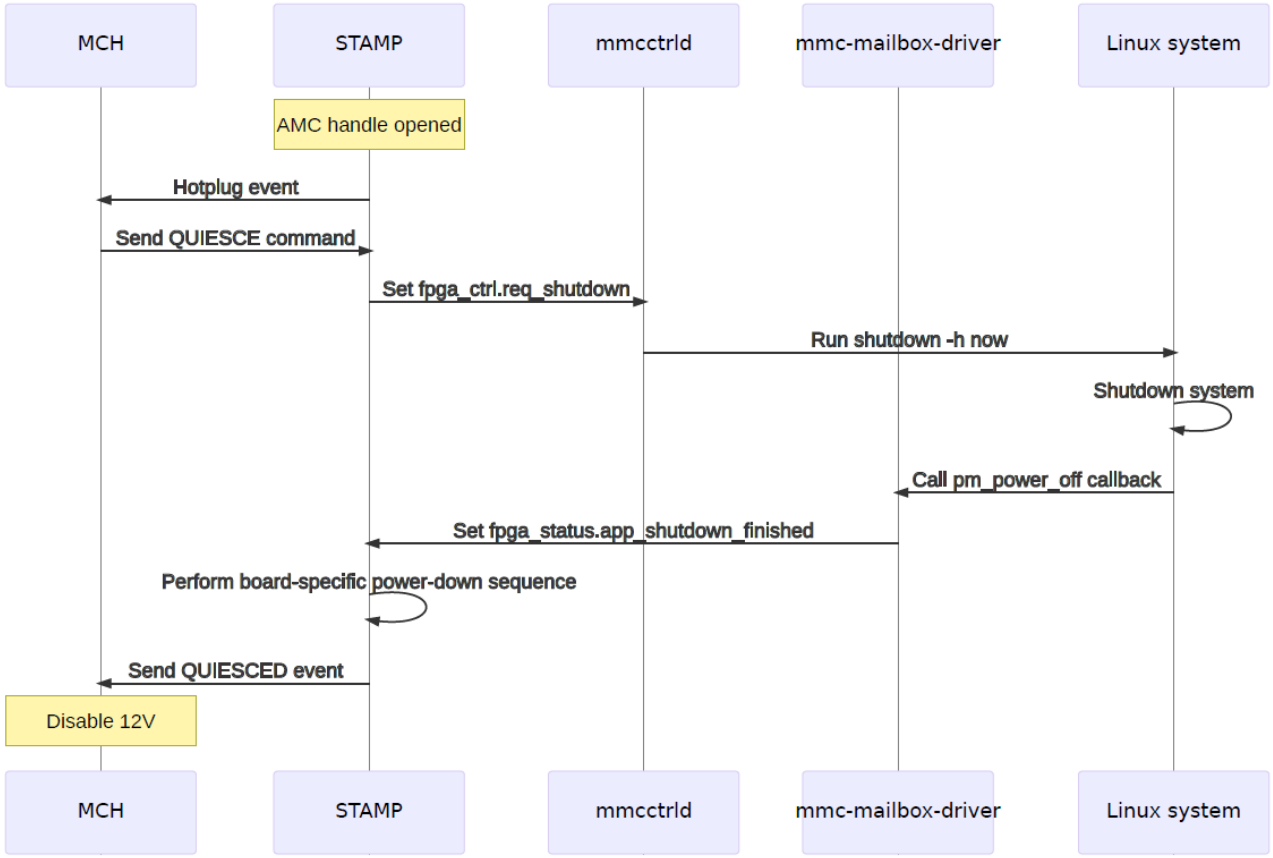
Memory Layout

	Offset	Size	Type	Name	Contents
	0	7	char[]	MMC Mailbox Magic String	"MMCMBOX"
	7	1	u8	MMC Mailbox Version	1
	8	256	FRU Information	FRU #0 Information	AMC Information
	264	256	FRU Information	FRU #1 Information	RTM Information
	520	256	FRU Information	FRU #2 Information	FMC1 Information
	776	256	FRU Information	FRU #3 Information	FMC2 Information
	1032	256	None	Application-specific	This area is not used by libdmmc. It is reserved for board-specific or application-specific implementation.
	1288	48	MMC Information	Information about MMC	
	1336	640	MMC Sensor []	Sensor #0..#39	All MMC sensors
	1976	69	None	Reserved	
	2045	1	Bitfield	FPGA Control	Bit 2..7: Reserved Bit 1: Request PCIe reset Bit 0: Request OS / Application Shutdown
	2046	1	Bitfield	FPGA Status	Bit 3..7: Reserved Bit 2: OS / Application Shutdown Finished Bit 1: OS / Application Failure Bit 0: OS / Application Startup Finished
	2047	1	Bitfield	Lock Register	Bit 1..7: Reserved Bit 0: Lock against update by MMC
Size:	2048				Note: Only "Lock Register" & "FPGA Status" written by FPGA. Everything else written by MMC

```
root@ZUP-0555 ~ mmcinfo sensors
MMC sensors
-----------
STAMP Temp    : 34.3125
AMC MP 3V3    : 3.38565
AMC PP 12V    : 12.4858
I_RTM MP 3V3 : 0
I_RTM PP 12V : 0
CPLD Done     : 1
RTM MP 3V3 P : 0
RTM PP 12V P : 0
RTM Fault     : 0
RTM Temp.1    : nan
PGood_A       : 1
PGood_B       : 1
FPGA1 Init    : 1
FPGA1 Done    : 1
FPGA2 Init    : 1
FPGA2 Done    : 1
Inlet Temp    : 38.3125
Outlet Temp   : 38.8125
LTM4630 Temp : 39.8741
LTM4650 Temp : 41.4658
LTM4633_F Te : 44.8637
LTM4633_R Te : 46.1143
ZUP IC Temp   : 47
S7 IC Temp    : 44
IMON_AVTT     : 0.580708
IMON_AVTTY    : 0.473748
IMON_AVCC     : 0.498168
IMON_AVCCY    : 0.263492
Vcore         : 0.720093
VCC_Vadj      : 1.80127
VCC_1V2       : 1.19946
FMC-4SFP+ PG : 1
```

MMC Mailbox

Embedded Linux Shutdown Sequence

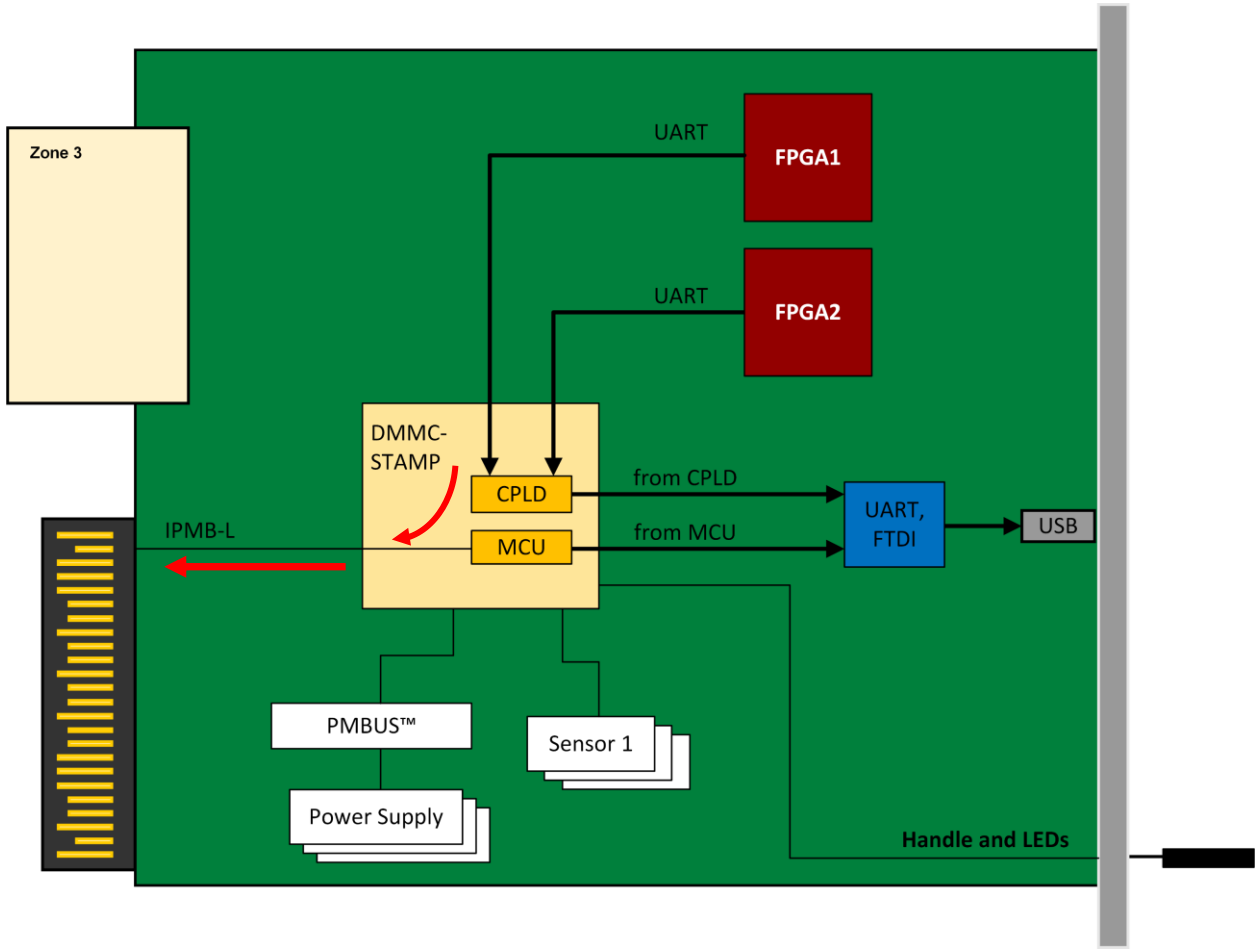


see talk by Patrick Huesmann today, 12:00 am

UART Forwarding to IPMB-L

Remote Access of the PS

> Improve UART multiplexing to remote access the PS by using *mmcterm*
  - System recovery in case of failure (e.g. network issues and ssh does not work anymore)
  - No need for USB cables anymore



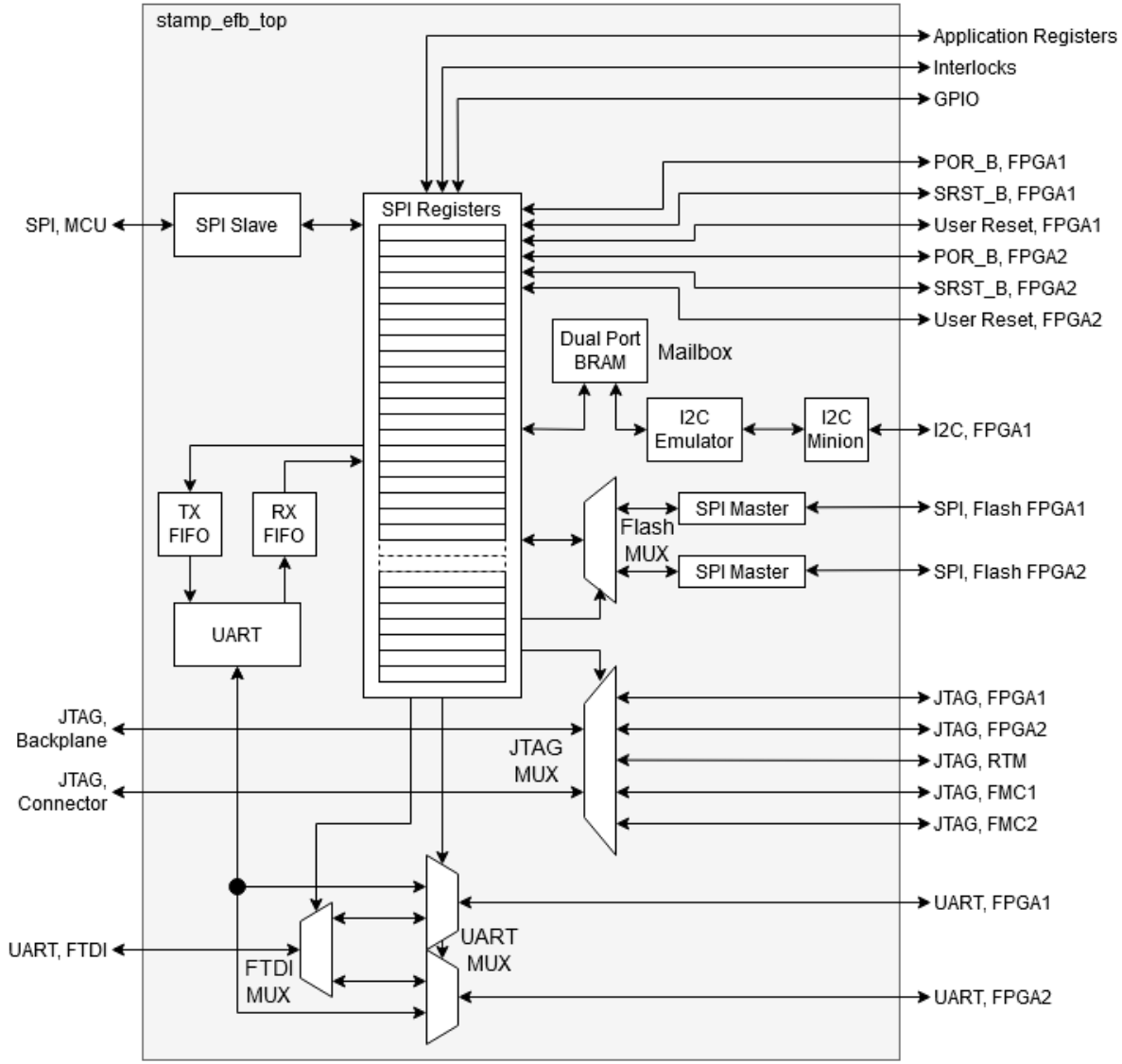
UART Forwarding to IPMB-L

SoC PS implementation

> Use Cases
- Remote Access
- System Recovery

```
huesmann@mskpcx29856 ~ mmcterm mskmchhvf1 0x7c -l
channel 0: MMC Console
channel 1: ZUP Console
huesmann@mskpcx29856 ~ mmcterm mskmchhvf1 0x7c -c 0
Press Ctrl-x to exit
DAMC-FMC2ZUP@0x7C MMC>v
App. version     : V2.00
 Build host, date: msktechjenkins.desy.de, 2022-10-24T09:53:58Z
 Compiler version: 10.2.1 20201103 (release)
Library version  : V2.00
 Build host, date: msktechjenkins.desy.de, 2022-10-24T09:53:33Z
 Compiler version: 10.2.1 20201103 (release)
IPMI version     : 1.5
Vendor ID        : 0x053F
Product ID       : 0x200B
Board            : DAMC-FMC2ZUP
STAMP revision   : Rev. C
STAMP UID        : 801F12F0B063
Copyright (C) 2022 Deutsches Elektronen-Synchrotron (DESY)
DAMC-FMC2ZUP@0x7C MMC>
huesmann@mskpcx29856 ~ mmcterm mskmchhvf1 0x7c -c 1
Press Ctrl-x to exit

ZUP-0555 login: root
root@ZUP-0555 ~ uname -a
Linux ZUP-0555 5.4.0-xilinx-v2020.2 #1 SMP Thu Nov 10 15:39:27 UTC 2022 aarch64 aarch64 aarch64 GNU/Linux
root@ZUP-0555 ~
```

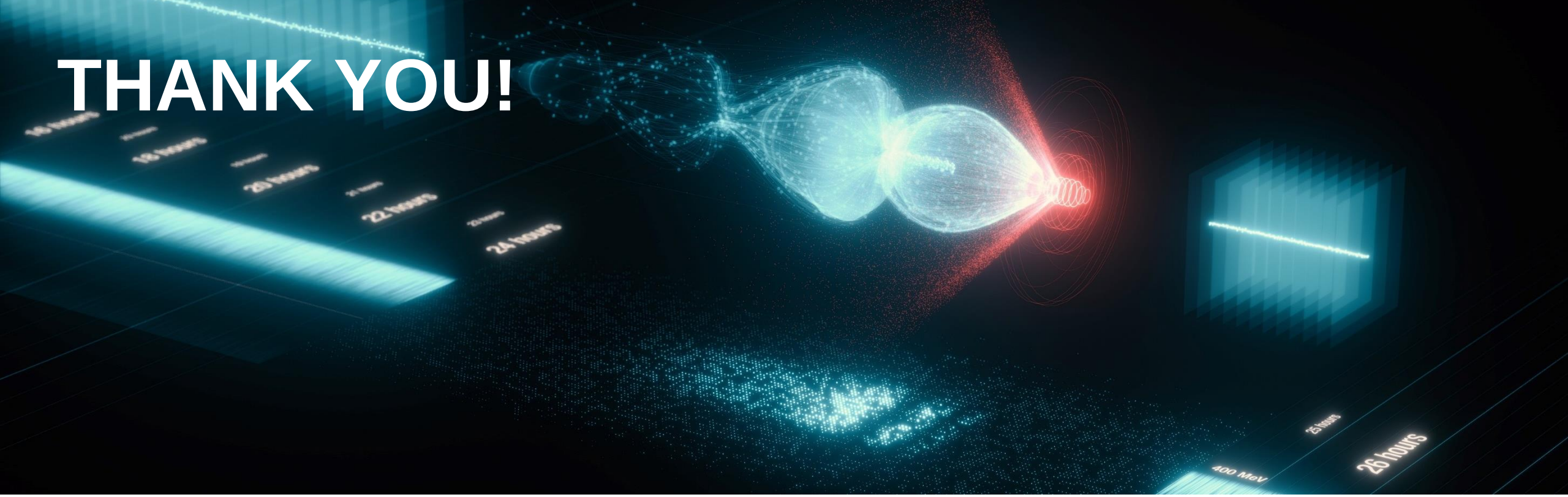


Conclusion

New Features and more Modularity

- Mailbox feature for communication between MMC and SoC
  - Deploy (critical) system information
  - Graceful shutdown of Linux OS
  - Application specific need
- PS UART forwarding to IPMB-L
  - Additional PS access channel (next to Ethernet and USB)
  - Very useful for remote access in case of a system failure
- Modular firmware/software implementation
  - Library based approach
  - Fully integrated with the DMMC-SDK
  - Clear separation to custom application part

THANK YOU!



Sven Stubbe
Head of MicroTCA Technology Lab
+49 (0)40 8998-1870
sven.stubbe@desy.de

Deutsches Elektronen-Synchrotron DESY
MicroTCA Technology Lab
Notkestraße 85
22607 Hamburg

MICROTCA TECHNOLOGY LAB

DESY.