Overview of MMC Stamp software development kit.
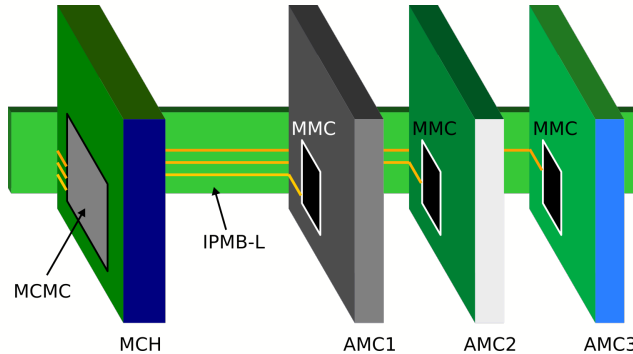
Patrick Huesmann (DESY)   2021-12-09

10th MicroTCA Workshop, Hamburg

microTCA TECHNOLOGY LAB   **HELMHOLTZ** RESEARCH FOR GRAND CHALLENGES

One of most important features of MicroTCA is out-of-band management interface.

MicroTCA Carrier Management Controller (MCMC) (part of MicroTCA Carrier Hub - MCH) connects to Module Management Controller (MMC) on Advanced Mezzanine Card (AMC)) over IPMB-L
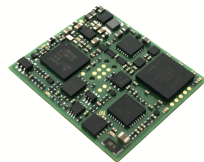
from: MMC Stamp and its applications, J. Marjanovic, MTCA Workshop China 2019

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  ► Original code based on a version from DESY MCS department
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- ▶ 2020: Standardization of software → MMC Stamp SDK
  - ▶ Existing codebase converted into shared MMC library
  - ▶ APIs created for board implementation
  - ▶ Added support for binary distribution of core library
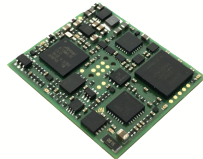
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▶ Sensors, thresholds & alerts
  ▶ temperatures
  ▶ voltages
  ▶ currents
  ▶ pin levels ...

```
nat> show_sensorinfo 10
Sensor Information for FRU 10 / AMC6
=======================================================================
    #   SDRType   Sensor  Entity  Inst   Value     State    Name
    -----------------------------------------------------------------
    -   MDevLoc           0xc1    0x66                       DAMC-FMC2ZUP
    0   Full      0xf2    0xc1    0x66   0x00               AMC Hot Swap
    1   Compact   0x0b    0xc1    0x66   0x00               801F12F0B063
    2   Full      Temp    0xc1    0x66   26.0 C    ok       STAMP Temp
    3   Full      Voltage 0xc1    0x66   3.352 V   ok       AMC MP 3V3
    4   Full      Voltage 0xc1    0x66   12.44 V   ok       AMC PP 12V
    5   Full      Current 0xc1    0x66   0.004 A   ok       I_RTM MP 3V3
    6   Full      Current 0xc1    0x66   0.00 A    ok       I_RTM PP 12V
    7   Compact   0x14    0xc1    0x66   0x01               0x00 CPLD Done
    8   Compact   0x14    0xc1    0x66   0x01               0x00 RTM MP 3V3 PG
    9   Compact   0x14    0xc1    0x66   0x00               0x00 RTM PP 12V PG
    10  Compact   0x14    0xc1    0x66   0x00               0x00 RTM Fault
    11  Compact   0x14    0xc1    0x66   0x01               0x00 PGood_A
    12  Compact   0x14    0xc1    0x66   0x01               0x00 PGood_B
    13  Compact   0x14    0xc1    0x66   0x00               0x00 FPGA1 Init
    14  Compact   0x14    0xc1    0x66   0x00               0x00 FPGA1 Done
    15  Compact   0x14    0xc1    0x66   0x00               0x00 FPGA2 Init
    16  Compact   0x14    0xc1    0x66   0x00               0x00 FPGA2 Done
    17  Full      Temp    0xc1    0x66   31.5 C    ok       Inlet Temp
    18  Full      Temp    0xc1    0x66   29.0 C    ok       Outlet Temp
    19  Full      Temp    0xc1    0x66   32.5 C    ok       LTM4630 Temp
    20  Full      Temp    0xc1    0x66   34.0 C    ok       LTM4650 Temp
    21  Full      Temp    0xc1    0x66   37.5 C    ok       LTM4633_F Temp
    22  Full      Temp    0xc1    0x66   38.0 C    ok       LTM4633_R Temp
    23  Full      Temp    0xc1    0x66   36.5 C    ok       ZUP IC Temp
    24  Full      Temp    0xc1    0x66   38.0 C    ok       S7 IC Temp
   ...
    -----------------------------------------------------------------
```

- ▶ IPMI control, Hotplug events

- ▶ FRU information (AMC, RTM, FMCs)

- ▶ Sensors, thresholds & alerts
  - ▶ temperatures
  - ▶ voltages
 - ▶ currents
  - ▶ pin levels . . .

- ▶ Payload management
  - ▶ Power management, start/stop payload
  - ▶ Custom CLI commands
  - ▶ Custom IPMI commands
  - ▶ Firmware update of payload (HPM)

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    7   Compact   0x14   0xc1  0x66  0x01     0x00      CPLD Done
    8   Compact   0x14   0xc1  0x66  0x01     0x00      RTM MP 3V3 PG
    9   Compact   0x14   0xc1  0x66  0x00     0x00      RTM PP 12V PG
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  ...
--------------------------------------------------------------------
```

see also: http://www.rehlich.com/MicroTCA_IPMI_management
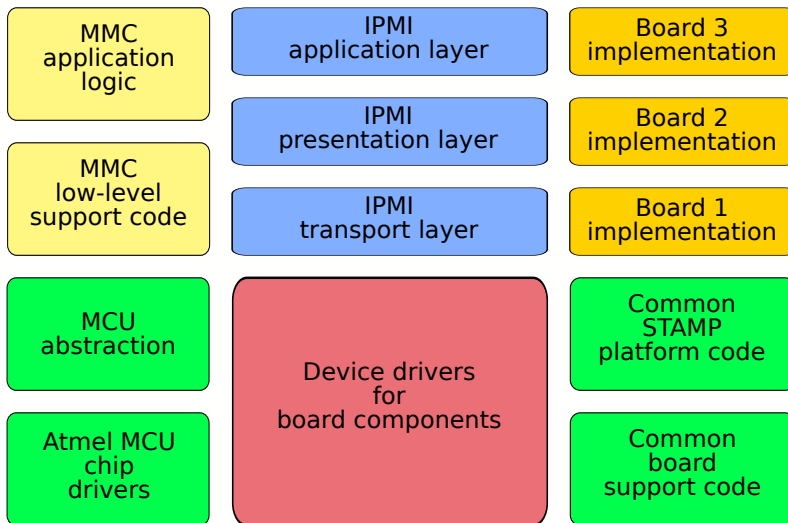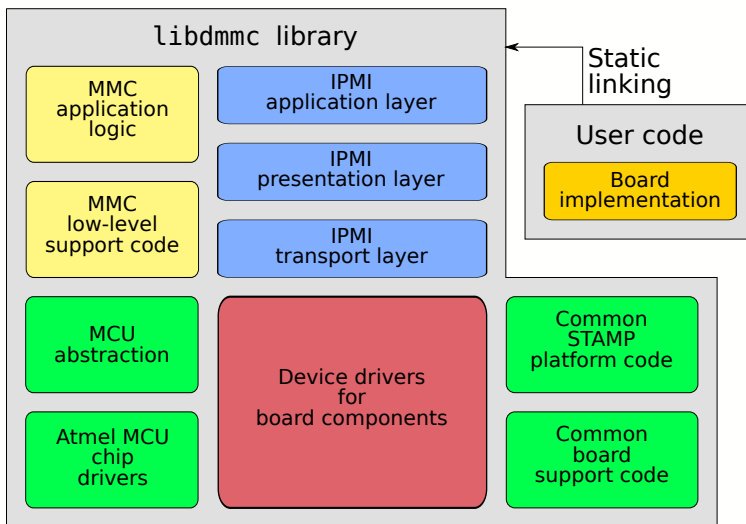
Features supported by **standard** MMC STAMP firmware out of the box:

▶ MCH comm, LEDs, power, RTM control

▶ On-board STAMP sensors

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Features requiring a **board-specific** firmware using MMC STAMP SDK:

- ▶ Additional sensors on user board
- ▶ MAC address forwarding to user FPGA
- ▶ Payload power sequencing
- ▶ User-specific GPIO control (MCU, CPLD)
- ▶ In-application update of payload via HPM.1
- ▶ Custom CLI commands
- ▶ Custom IPMI commands

MMC SDK: Power management
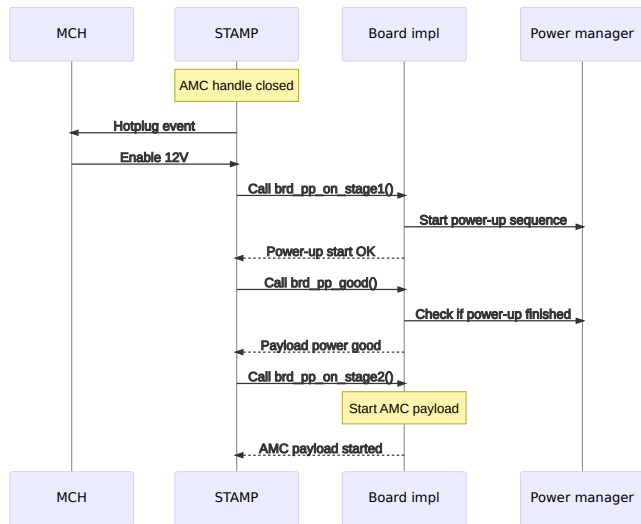
Board implementation:

▶ `brd_pp_on_stage1()`
  Start power-up sequence

▶ `brd_pp_good()`
  Check if power-up sequence
  finished

▶ `brd_pp_on_stage2()`
  Start the board payload

▶ `brd_set_z3_drv_enable()`
  Zone 3 interface enable/disable
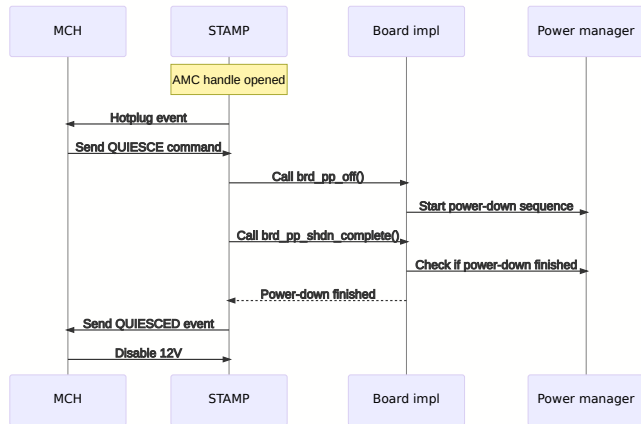
Board implementation:

▶ `brd_pp_off()`
Start power-down sequence

▶ `brd_pp_shdn_complete()`
Check if power-down sequence is finished

MMC SDK: Sensor API

Two kinds of IPMI sensors:

▶ "Compact" sensors (only 0 and 1)

▶ "Full" sensors (numerical value)

```
$ ipmitool -H mskmchhvf1.tech.lab -A NONE -B 0 -T 0x82 -t 0x7c -b 7 sensor
...
RTM MP 3V3 PG   | 0x1   | discrete  | 0x0000| na      | na      | na      | na      | na      | na
RTM PP 12V PG   | 0x0   | discrete  | 0x0000| na      | na      | na      | na      | na      | na
...
```

Two kinds of IPMI sensors:

▶ "Compact" sensors (only 0 and 1)
▶ "Full" sensors (numerical value)

Full sensors provide a numeric reading w/ engineering unit, range and thresholds

▶ Sensor type: Voltage, Current or Temperature
▶ Can be I2C sensor or STAMP analog input
▶ Callbacks for read fn and optional enable / postprocessing fn

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RTM MP 3V3 PG    | 0x1      | discrete   | 0x0000| na      | na      | na      | na      | na      | na
RTM PP 12V PG    | 0x0      | discrete   | 0x0000| na      | na      | na      | na      | na      | na
...
Inlet Temp       | 24.000   | degrees C  | ok    | 0.000   | 3.000   | 5.000   | 60.000  | 70.000  | 75.000
Outlet Temp      | 22.000   | degrees C  | ok    | 0.000   | 3.000   | 5.000   | 60.000  | 70.000  | 75.000
LTM4630 Temp     | 26.000   | degrees C  | ok    | 0.000   | 3.000   | 5.000   | 60.000  | 70.000  | 75.000
LTM4650 Temp     | 26.500   | degrees C  | ok    | 0.000   | 3.000   | 5.000   | 60.000  | 70.000  | 75.000
...
VCC_1V2          | 1.200    | Volts      | ok    | 1.018   | 1.075   | 1.133   | 1.258   | 1.315   | 1.373
...
```

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    ▶ LM95214 Remote diode & local temp.
                $\rightarrow$ Typical use: Measuring IC temperatures (e.g. of big FPGAs)

    ▶ ADS101x 12bit ADC
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Sensors that are not supported out of the box can be easily integrated by providing a driver function:

```
float (*read_func)(const full_sensor_config_t* arg);
```

MMC SDK: Custom console & IPMI commands

Custom CLI commands

▶ Command struct contains command name, argument list description, short help text
▶ Callback function signature:

```
void (*mmc_cli_func)(int argc, char** argv);
```

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```

Custom IPMI commands

▶ Command struct contains netfn, command code, name and callback

▶ Callback function signature:

```
void (*ipmi_cmd_handler)(ipmi_call_t* call);
```

▶ Callback function accesses IPMI message payload

  ▶ `req_read_u8(),u16(),u32()`: Reads unsigned little-endian value from IPMI request
  ▶ `rsp_write_u8(),u16(),u32()`: Writes unsigned little-endian value to IPMI response
  ▶ `rsp_finish()`: Finishes a response, sets IPMI completion code

SDK application example: DAMC-FMC1Z7IO

How many LOC necessary to implement a MMC for a modern FMC carrier using the STAMP SDK?

```
$ cloc damc-fmc1z7io/src --by-file --quiet

-------------------------------------------------------------------------
File                                    blank      comment      code
-------------------------------------------------------------------------
damc-fmc1z7io/src/board_impl.c           19          27         235
damc-fmc1z7io/src/board_cli.c            22          19         220
damc-fmc1z7io/src/board_payload.c        29          25         109
damc-fmc1z7io/src/board_priv.c           16          22         100
damc-fmc1z7io/src/board_priv.h           17          17          64
damc-fmc1z7io/src/board_eeprom.c          5          11          18
damc-fmc1z7io/src/board_eeprom.h          7          11          13
damc-fmc1z7io/src/main.c                  2          11          11
damc-fmc1z7io/src/board_cli.h             2          11           3
-------------------------------------------------------------------------
SUM:                                     119         154         773
-------------------------------------------------------------------------
```

$\Rightarrow$ MMC implemented in less than 800 LOC total 🎉

microTCA TECHNOLOGY LAB   HELMHOLTZ RESEARCH FOR GRAND CHALLENGES   DESY.

Thank you

https://techlab.desy.de

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