MTCA.4 Tutorial

MicroTCA Management

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Agenda

- Introduction and Overview
- Shelf Management in xTCA Systems
- xTCA for Physics Extension
- IPMI Implementation for MMC and RTM

Keep it Running...

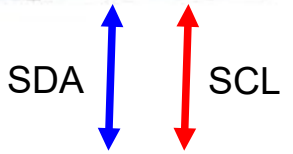
- **Intelligent Platform Management Interface** – protocol initially developed by Intel, Hewlett-Packard, NEC and DELL consortium
- Used by system administrators for out-of-band management of computer systems and monitoring of their operation
- First draft available in Spring '98 (IPMI v0.9)
- **RAS** Features Focus:
  - **R**eliability
  - **A**vailability
  - **S**erviceability
- Server oriented:
  - Remote administration
  - Expensive hardware
  - High costs of downtime and repair
- Plug and Play, Hot-swap

SuperBlade supercomputer
source: www.supermicro.com

IPMI Elements

- **Field Replaceable Unit (FRU)**

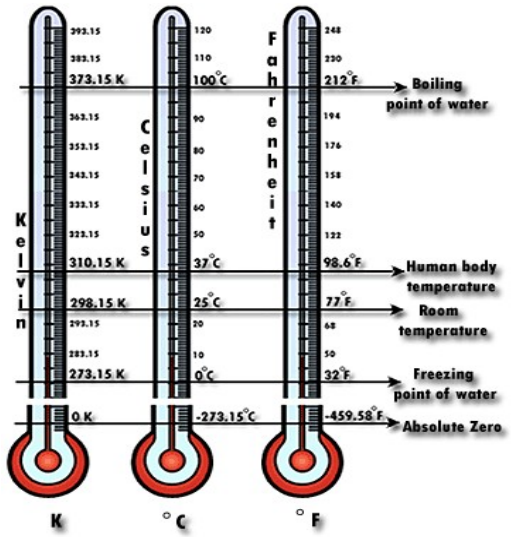
Field replaceable components of the system such as a board, module, fan unit, power supply module, raid matrix, etc.
FRU records are stored in a non-volatile memory.

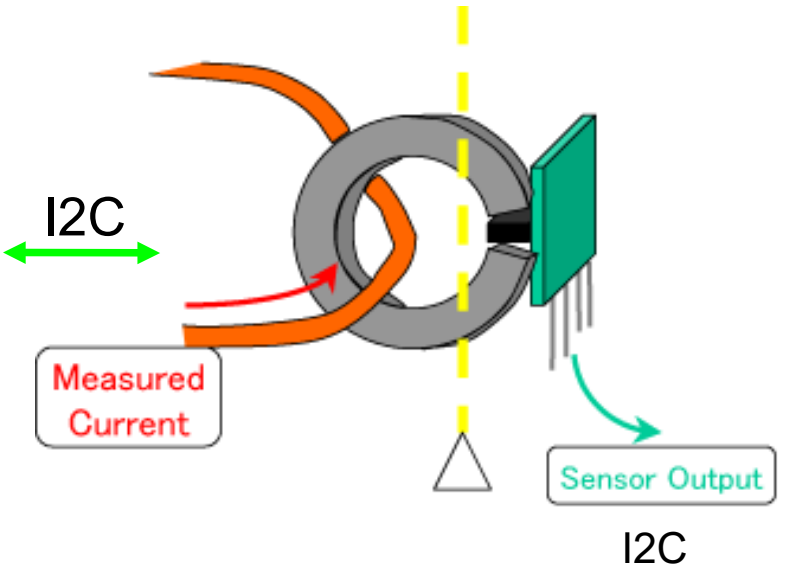


I2C

- **Sensor Data Record (SDR)**

Provide information about available on FRU sensors, events, management controllers, e.g. temperatures, voltages, sensors, etc.

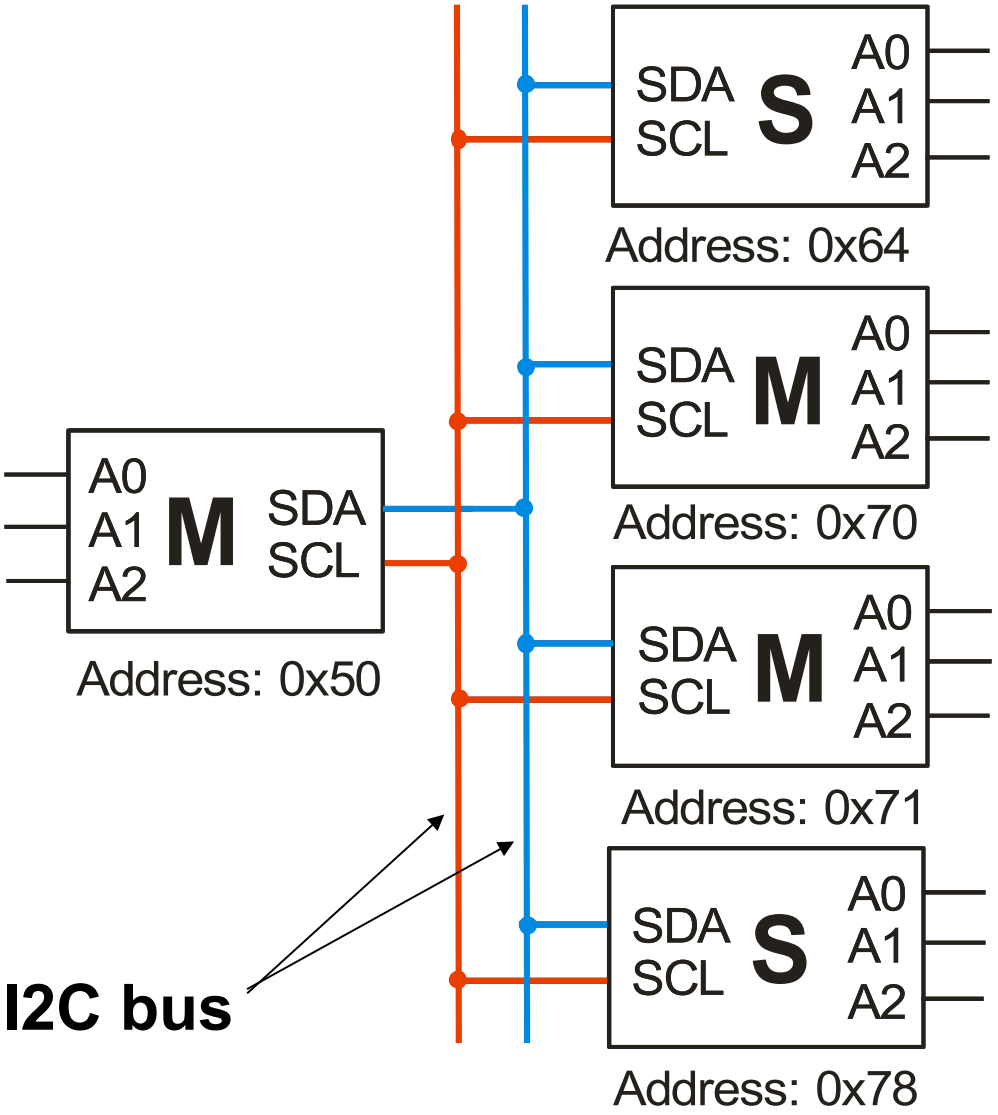




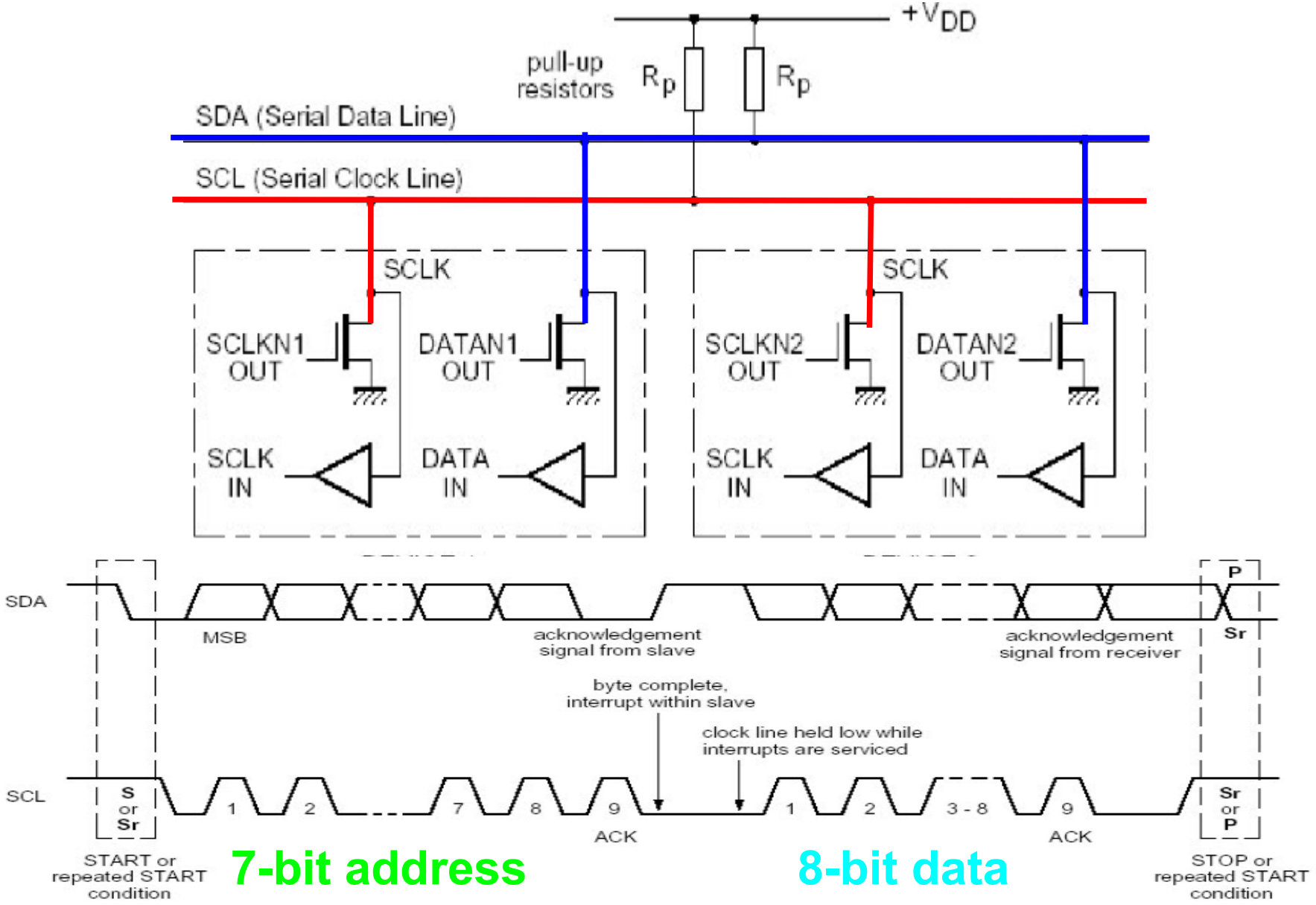
I2C

I2C Interface – IPMI Backbone (1)

- I2C – Inter-Integrated Circuit bus
- Standard developed by Philips on early 80s
- Two wire synchronous, half-duplex interface (SDA – data line, SCL – clock line)
- Bidirectional multi master-slave transfers, 8-bit frames
- Transmission speed: 100 kbps, 400 kbps, 3.4 Mbps
- 7-bit or 10-bits device address
- Arbitration used for multi-master transmission



I2C Interface – IPMI Backbone (2)



Shelf Management in xTCA Systems

xTCA and IPMI

- IPMI introduced in PICMG 2.16 backplanes (CompactPCI systems) and later in AdvancedTCA, AMC and MicroTCA standards
- IPMI enables "diagnose-before-dispatch" automation
- Required for 99.999 percent high availability (HA) mark
- IPMI controller (shelf manager) is responsible for:
  - Monitoring overall shelf health
  - Communicating with remote System Management Software (SMS)
  - Hot-swap events (e.g. hardware component entry-removal events)
  - Latch/lock management
  - Power budgeting
  - In-rush current sequencing
  - Electronic keying (E-keying)
- PICMG 3.0 extension commands
- HPM.1 management firmware upgrade capability

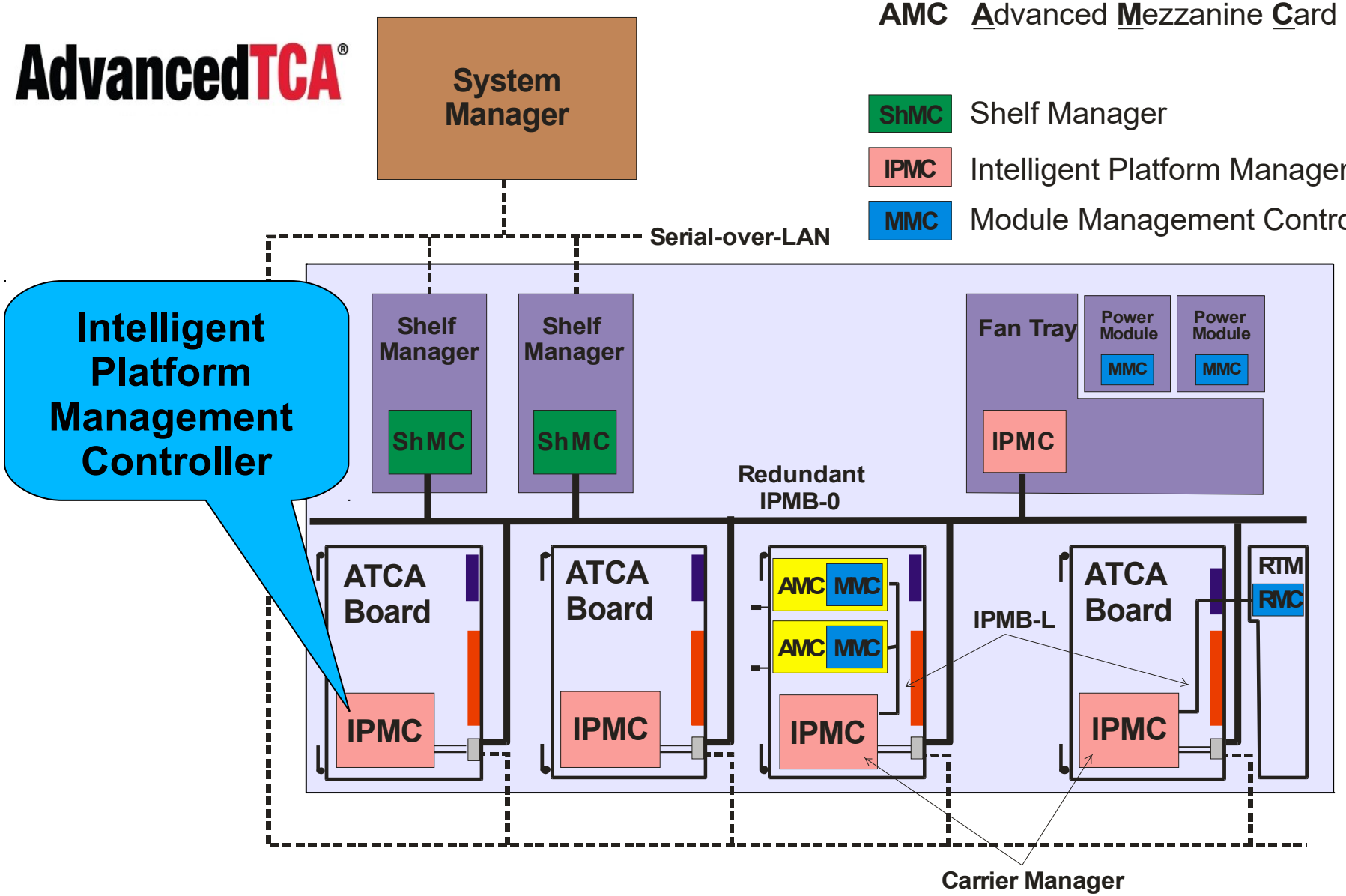
ATCA Shelf Management System

AMC Advanced Mezzanine Card

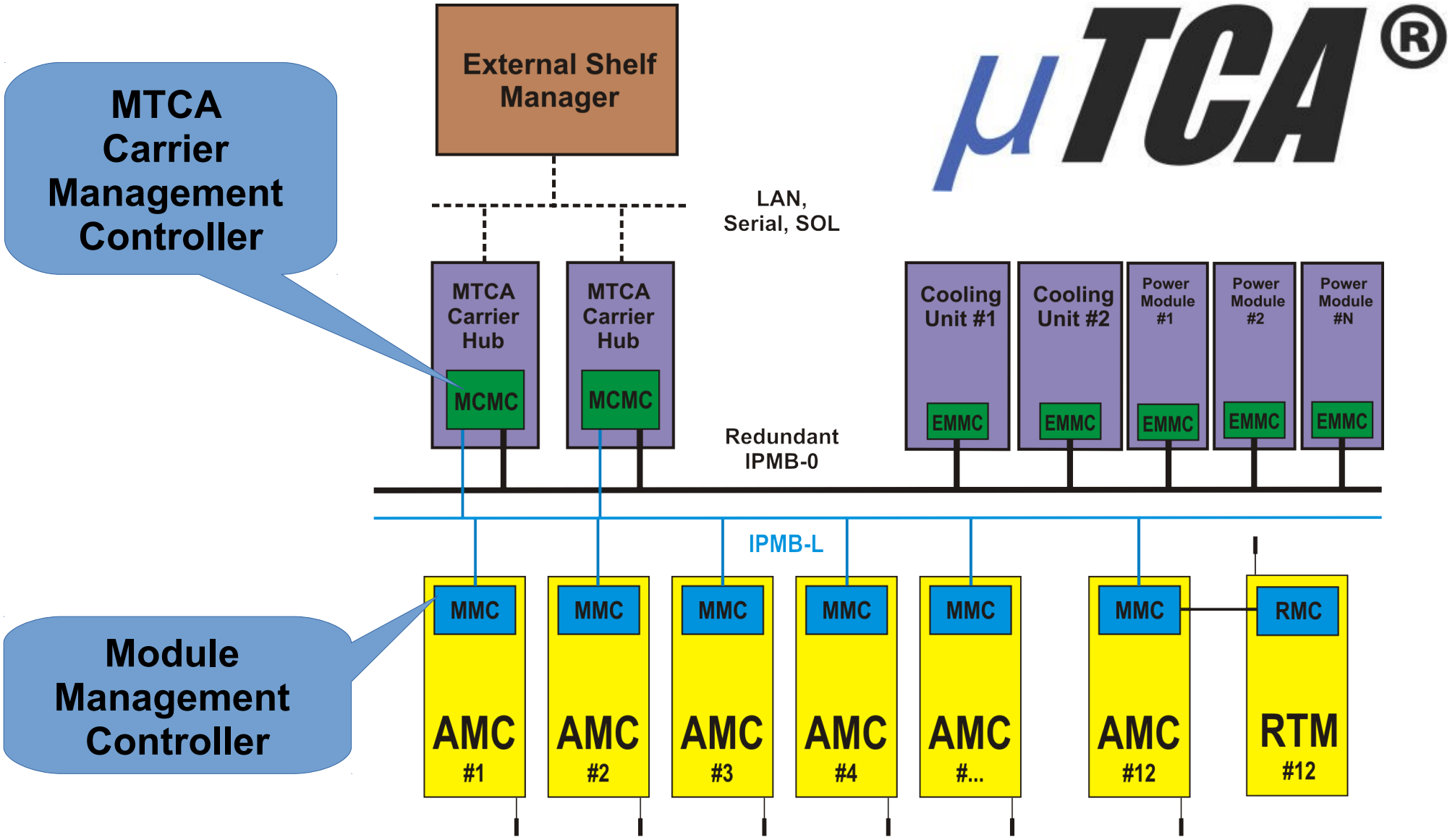
ShMC Shelf Manager

IPMC Intelligent Platform Management Controller

MMC Module Management Controller

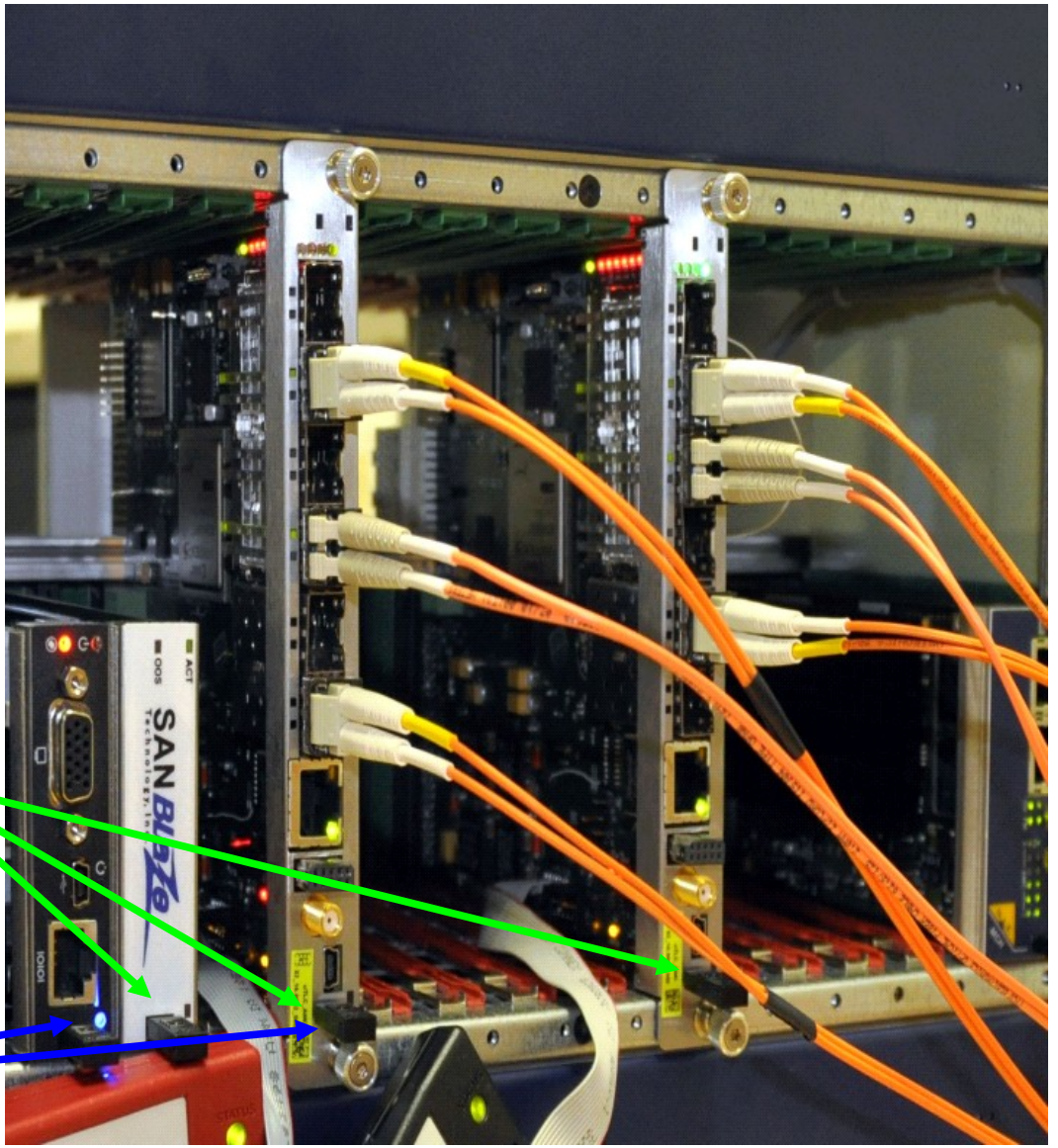


MTCA Shelf Management System



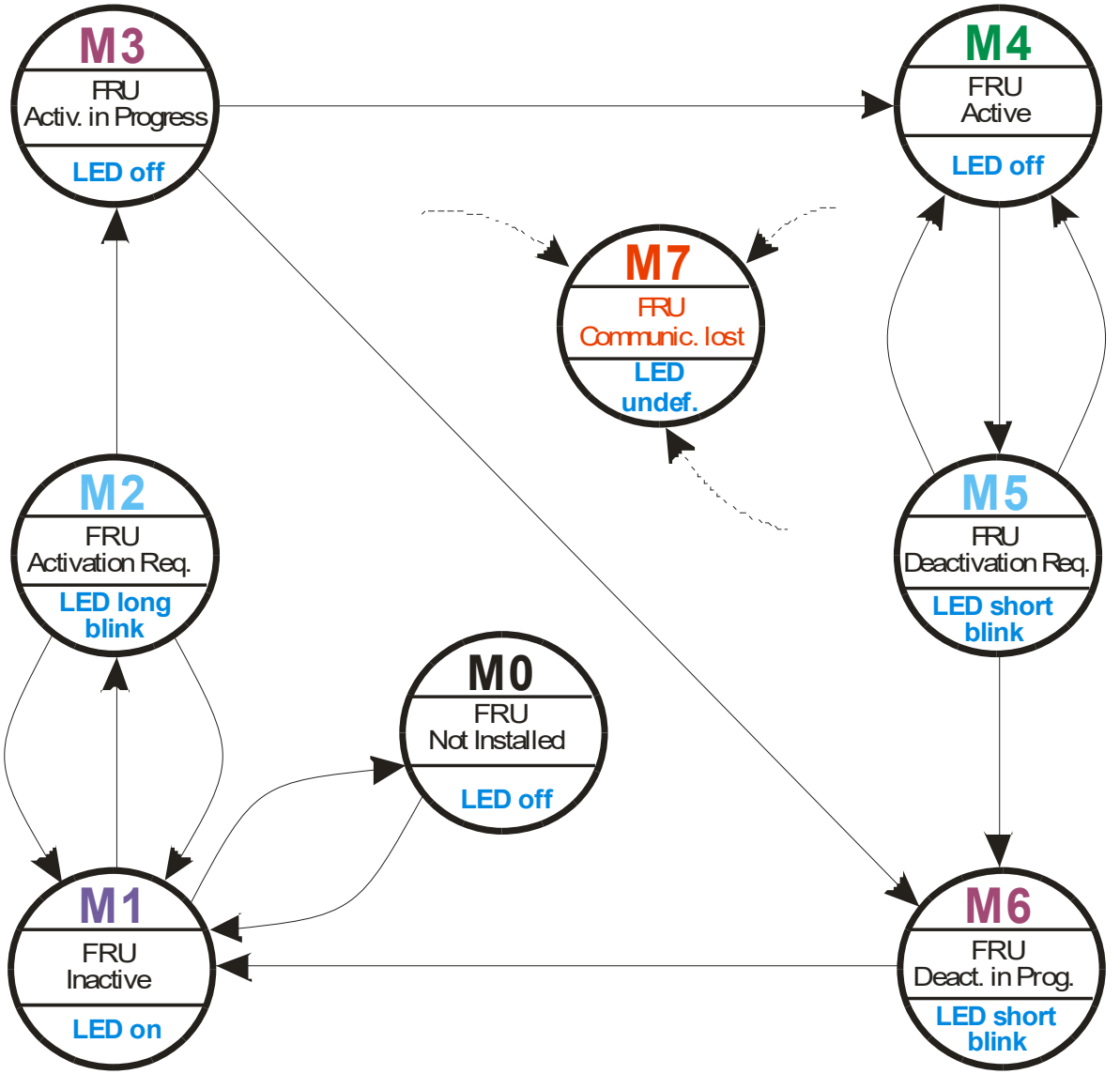
AMC Module Hot-plug

- What really happens when you plug AMC card into MTCA chassis?
- Module Activation procedure?
- Module Deactivation?
- How IPMI automates this process?
- What if something goes wrong?

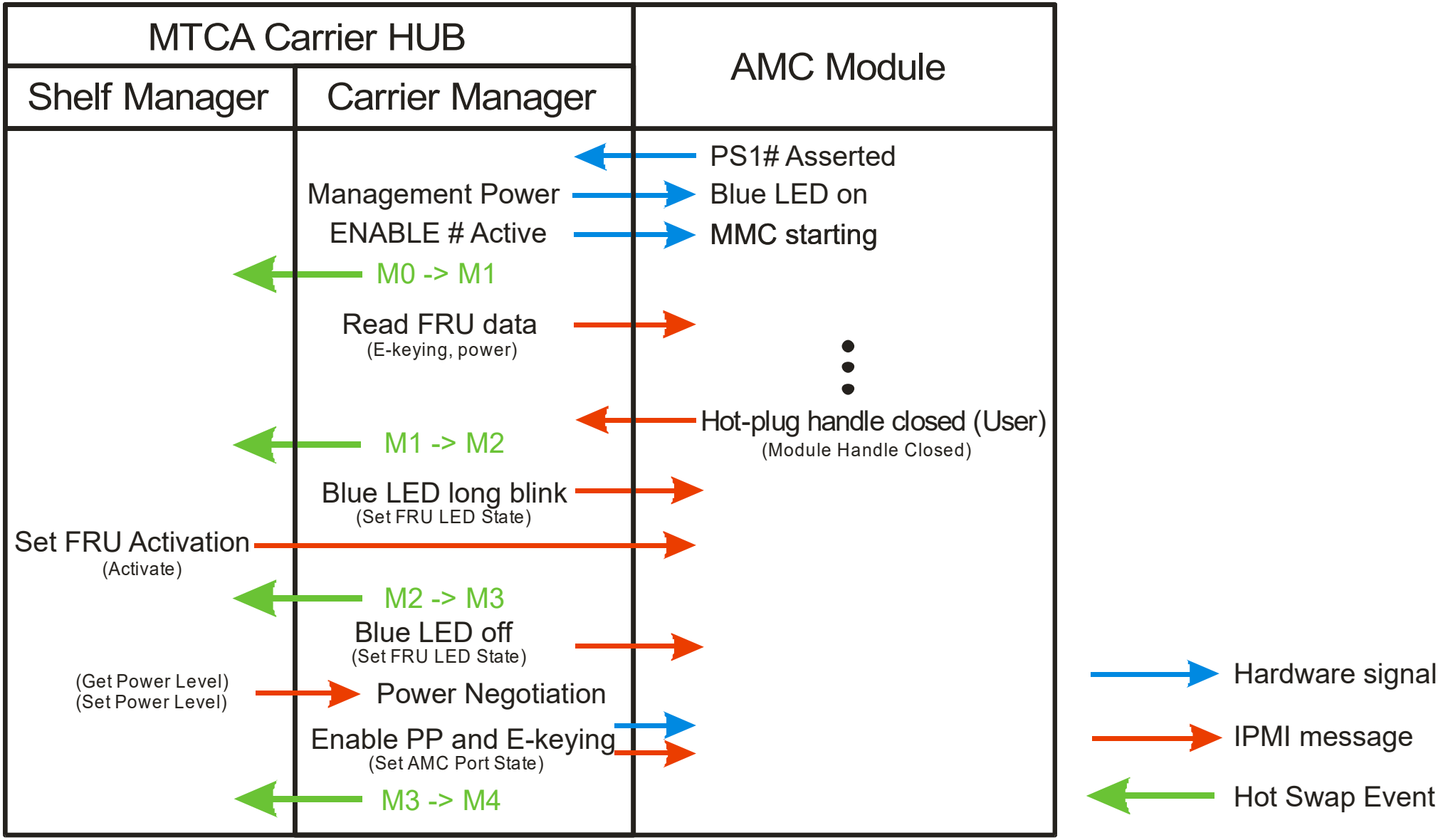


Module Activation/Deactivation

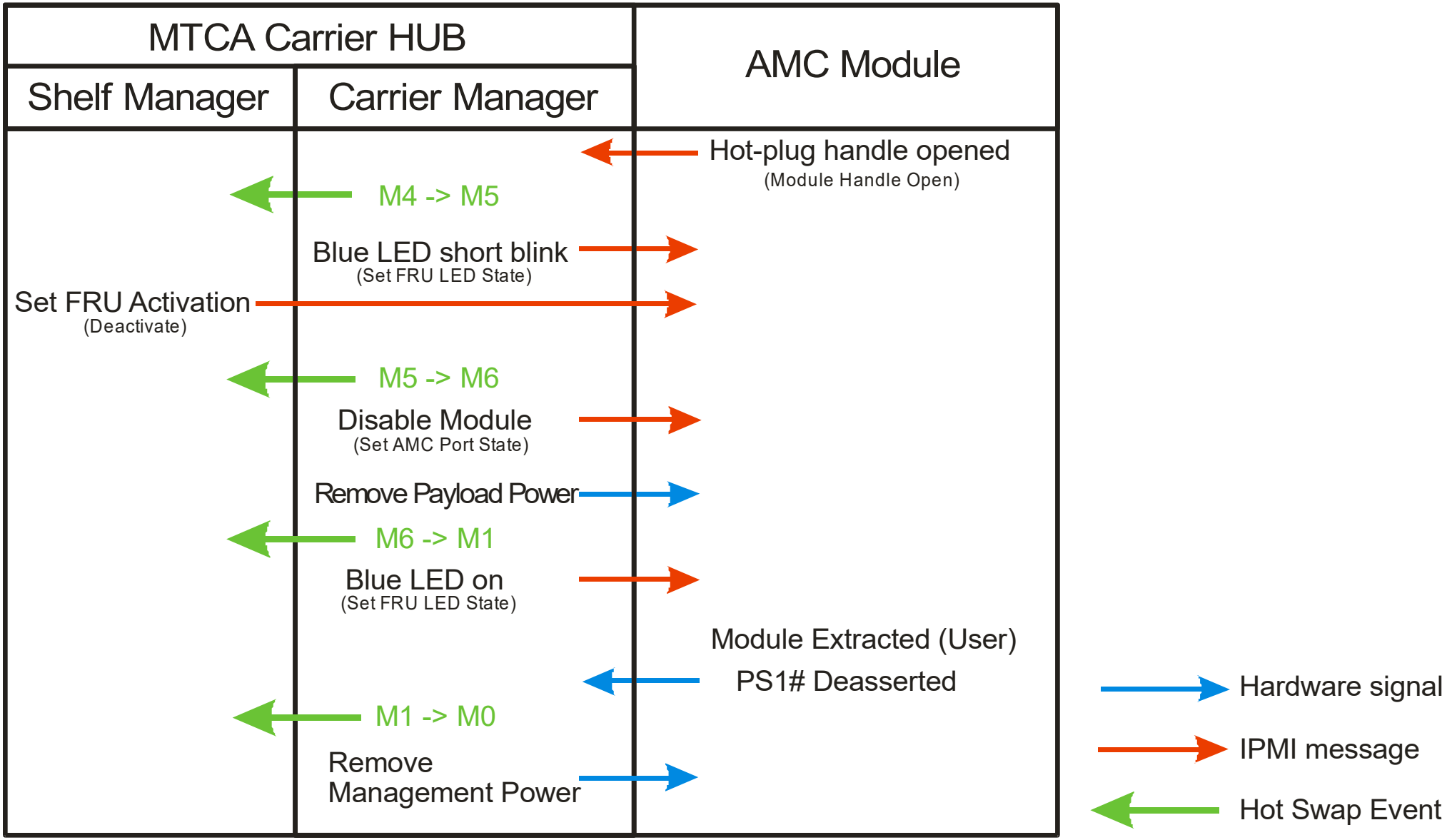
- PICMG 3.0 and AMC specifications define FRU states
- Activation pushes FRU into M4 state
- Deactivation moves FRU into M1 state
- If something wrong happen module goes into M7 state
- MCH decides if and when module can reach M4
- MMC uses a state machine to control hot-plug procedure



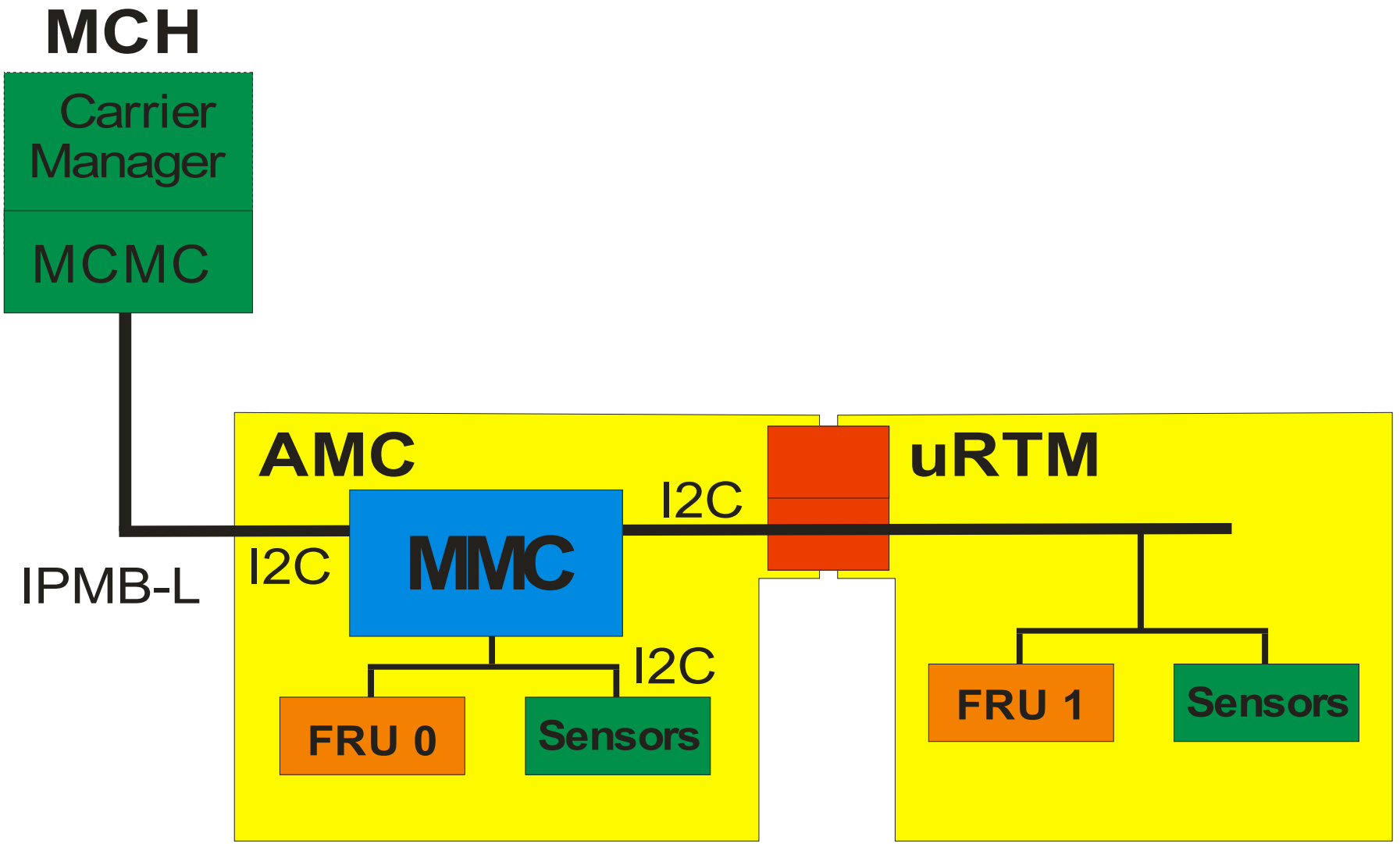
AMC Module Insertion



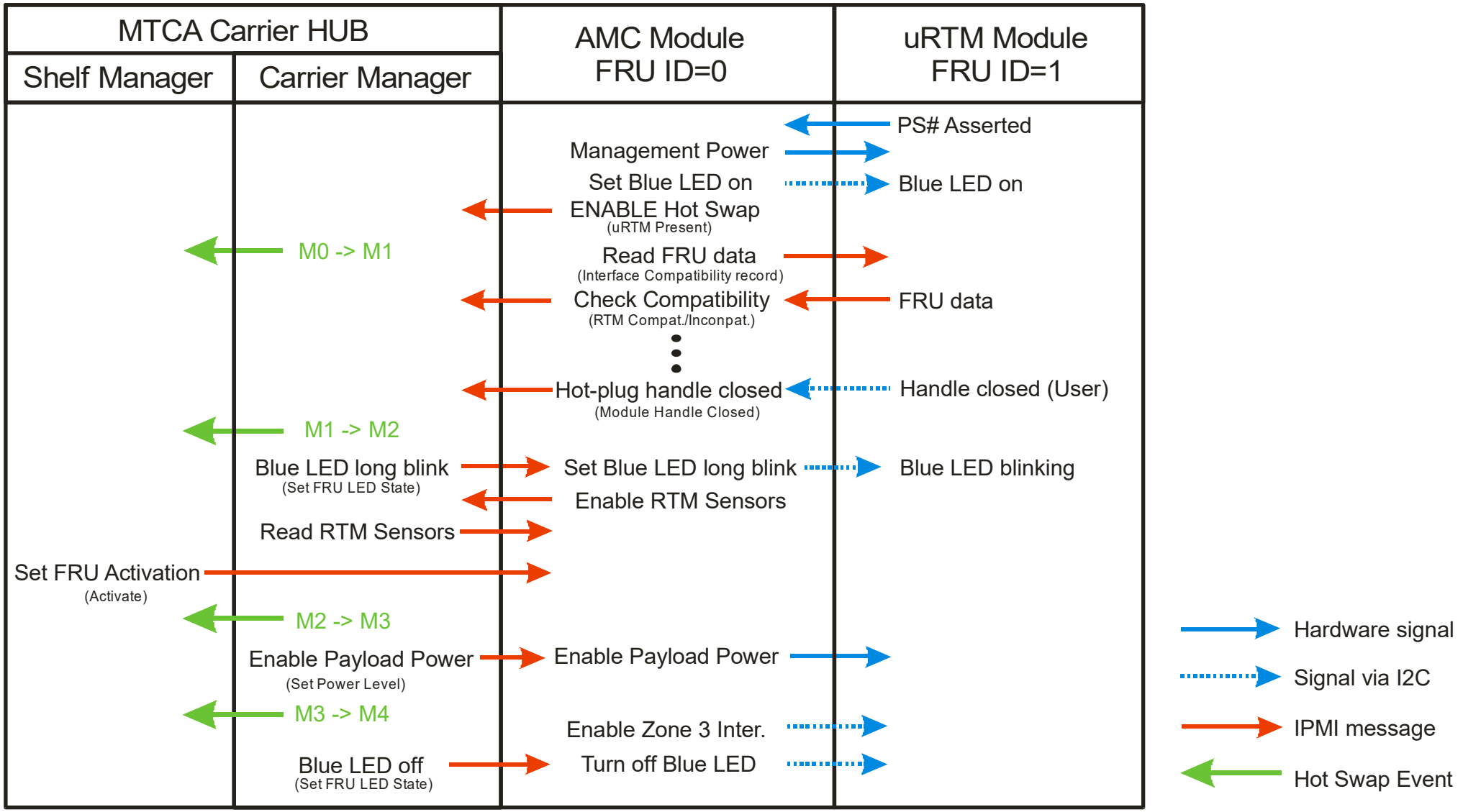
AMC Module Extraction



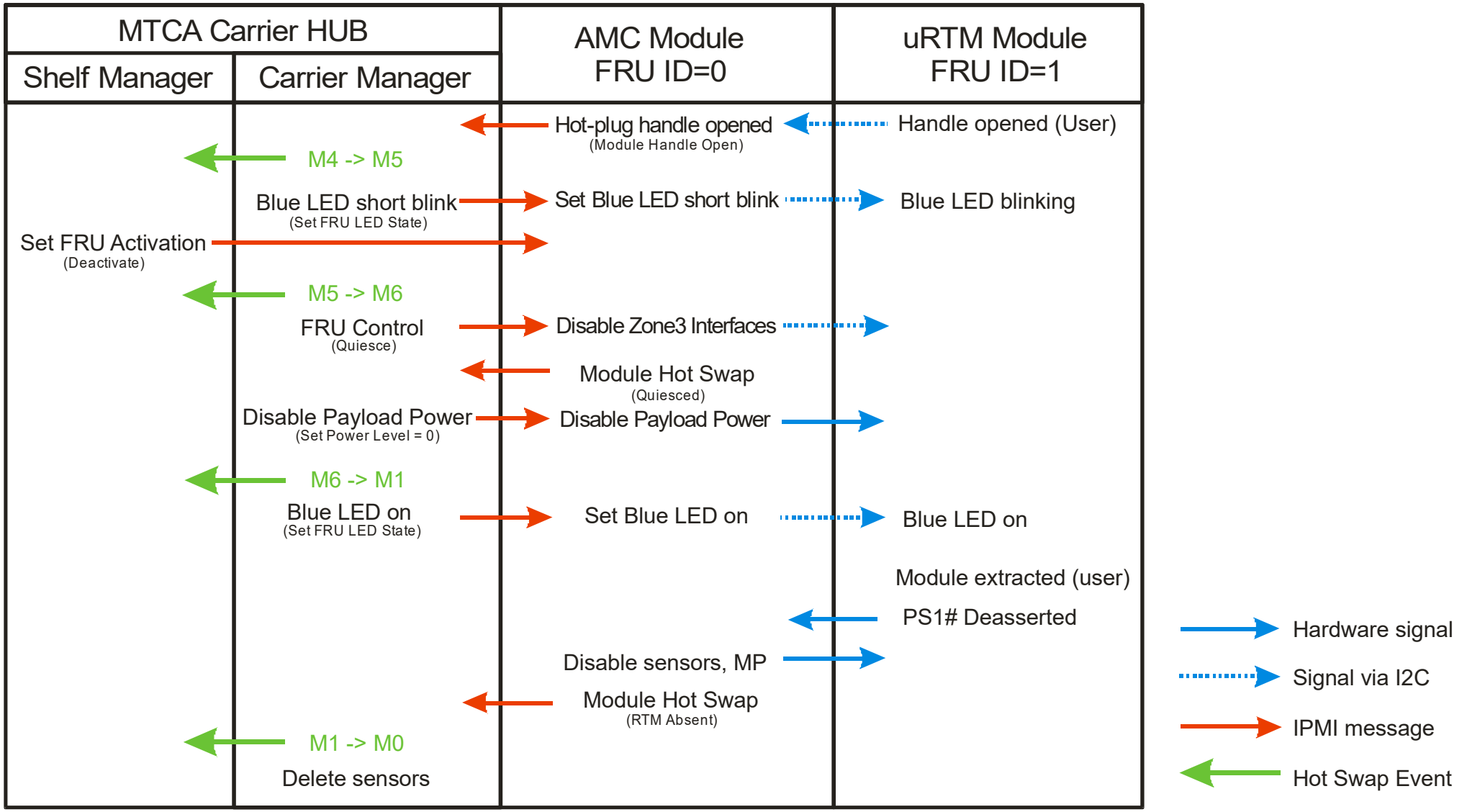
MTCA.4 – Hardware Management



RTM Module Insertion



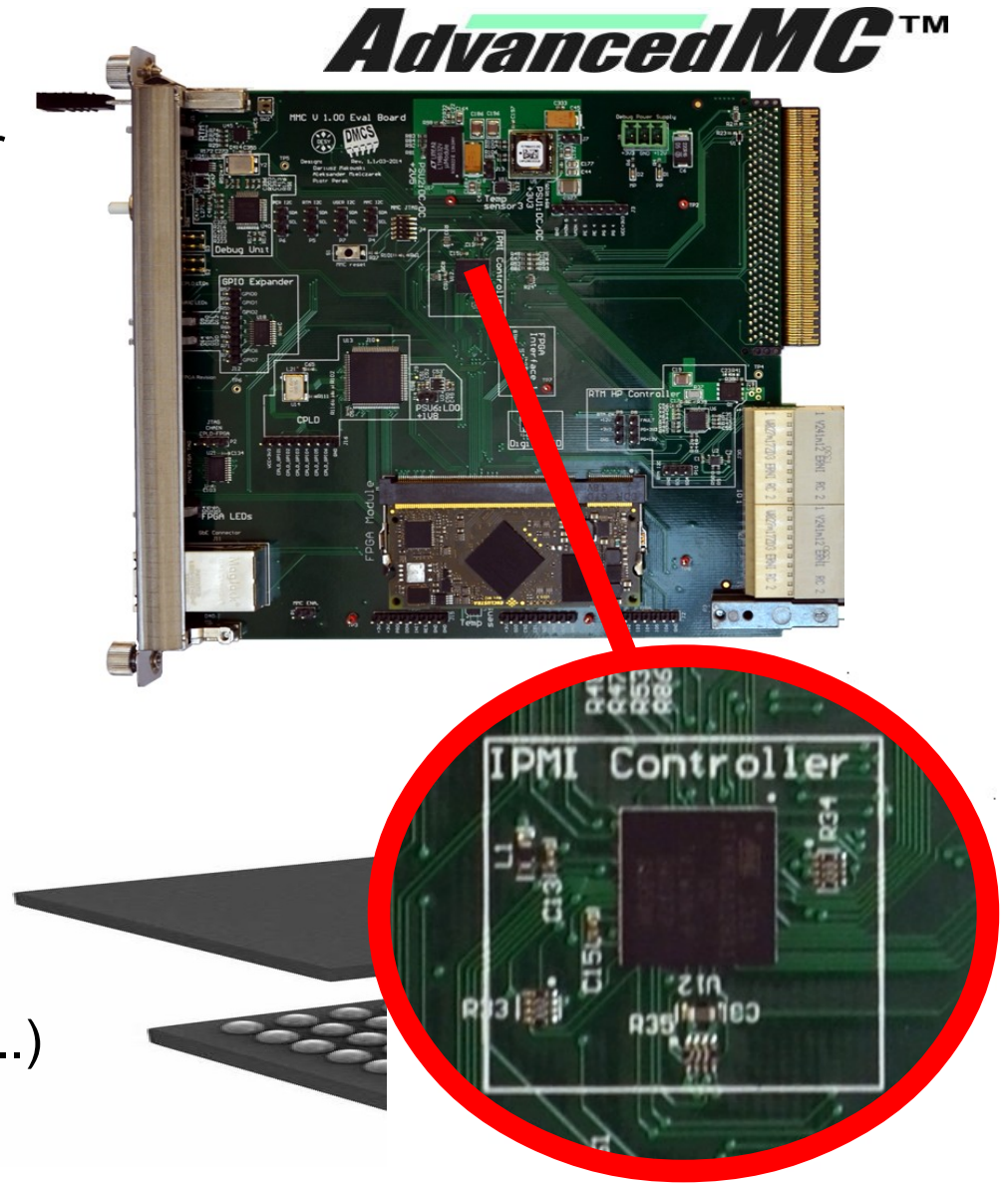
RTM Module Extraction



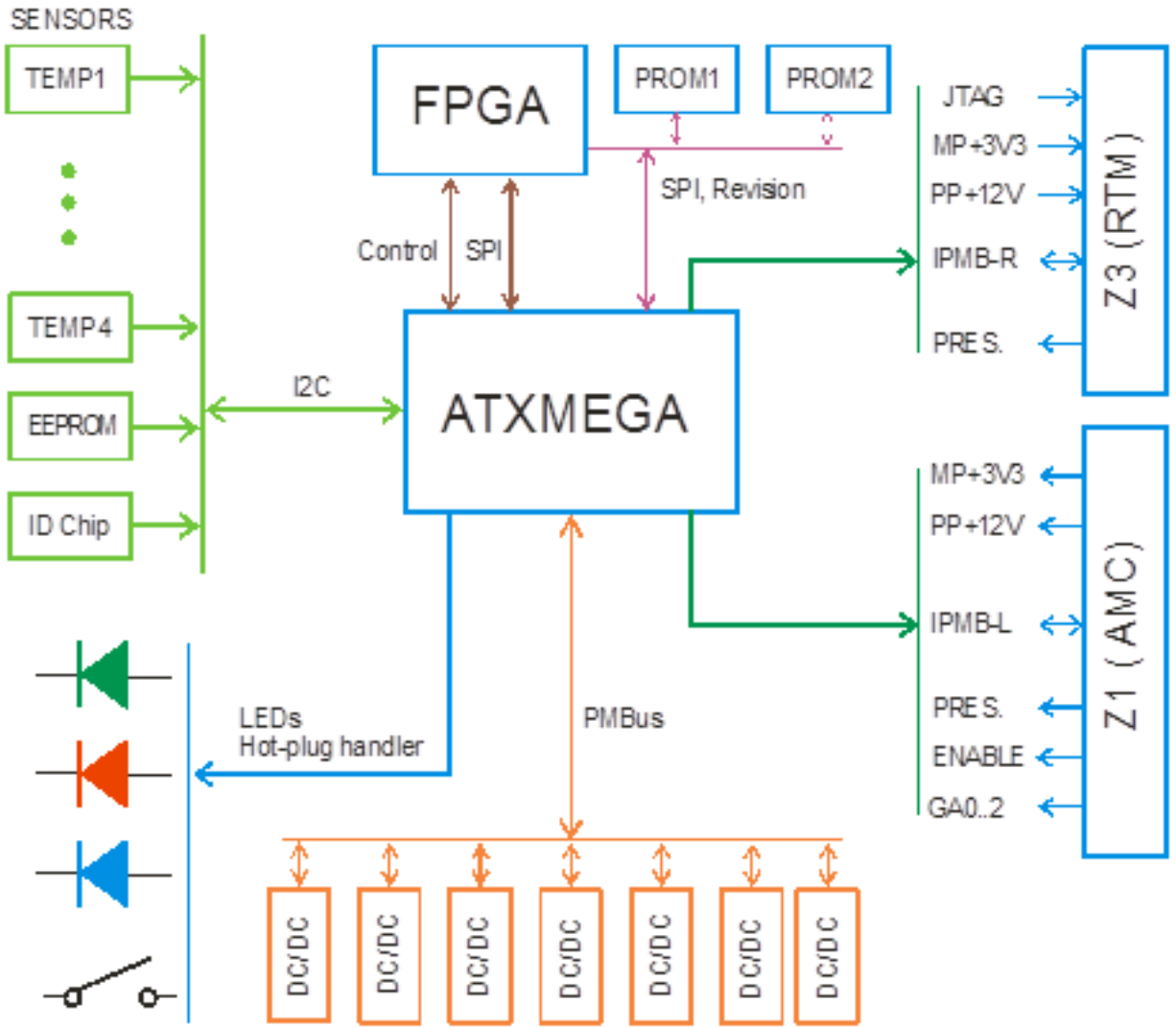
Module Management Controller (AMC Module)

Module Management Controller

- Required on each AMC Module
- Communication with the Carrier Manager
- Module management:
  - Module activation and deactivation
  - Warm and cold module reset
  - Power supply management
- Monitoring of module crucial parameters
  - Temperature
  - Supply voltages
  - Currents
  - Clocks, etc.
- E-keying mechanism (PCIe, GbE, sRIO,...)
- Supervision of µRTM module (MTCA.4)



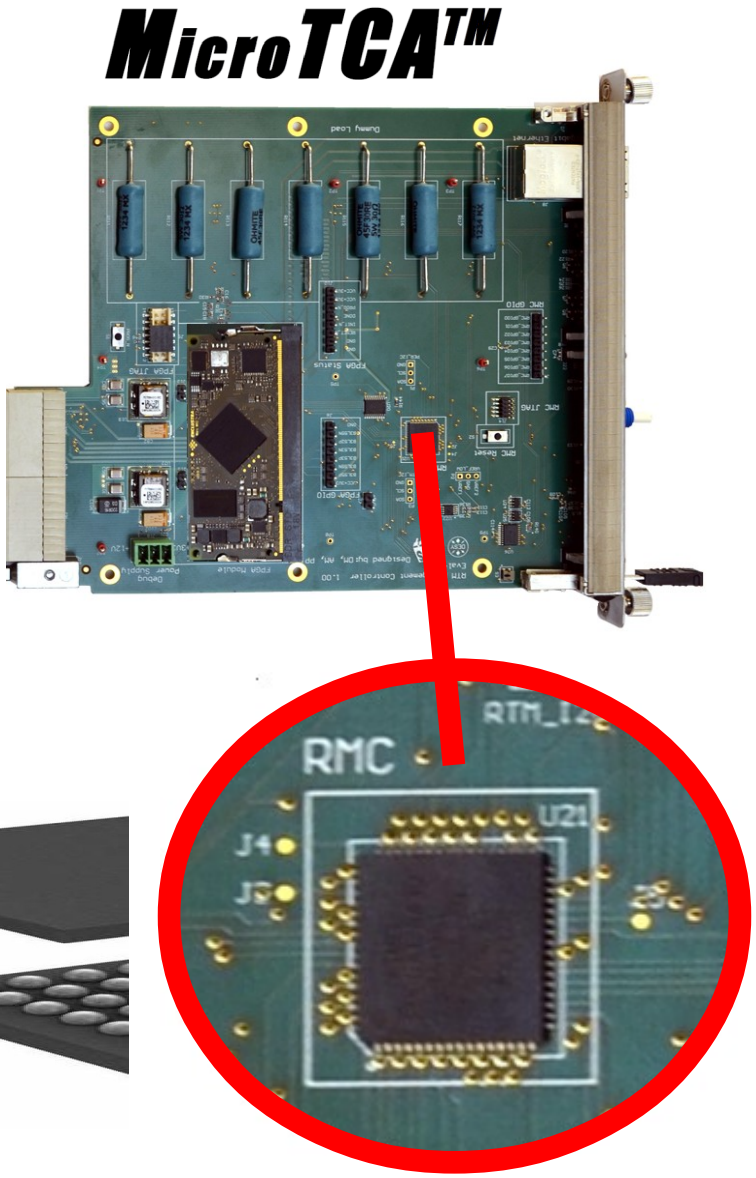
Block Diagram of MMC



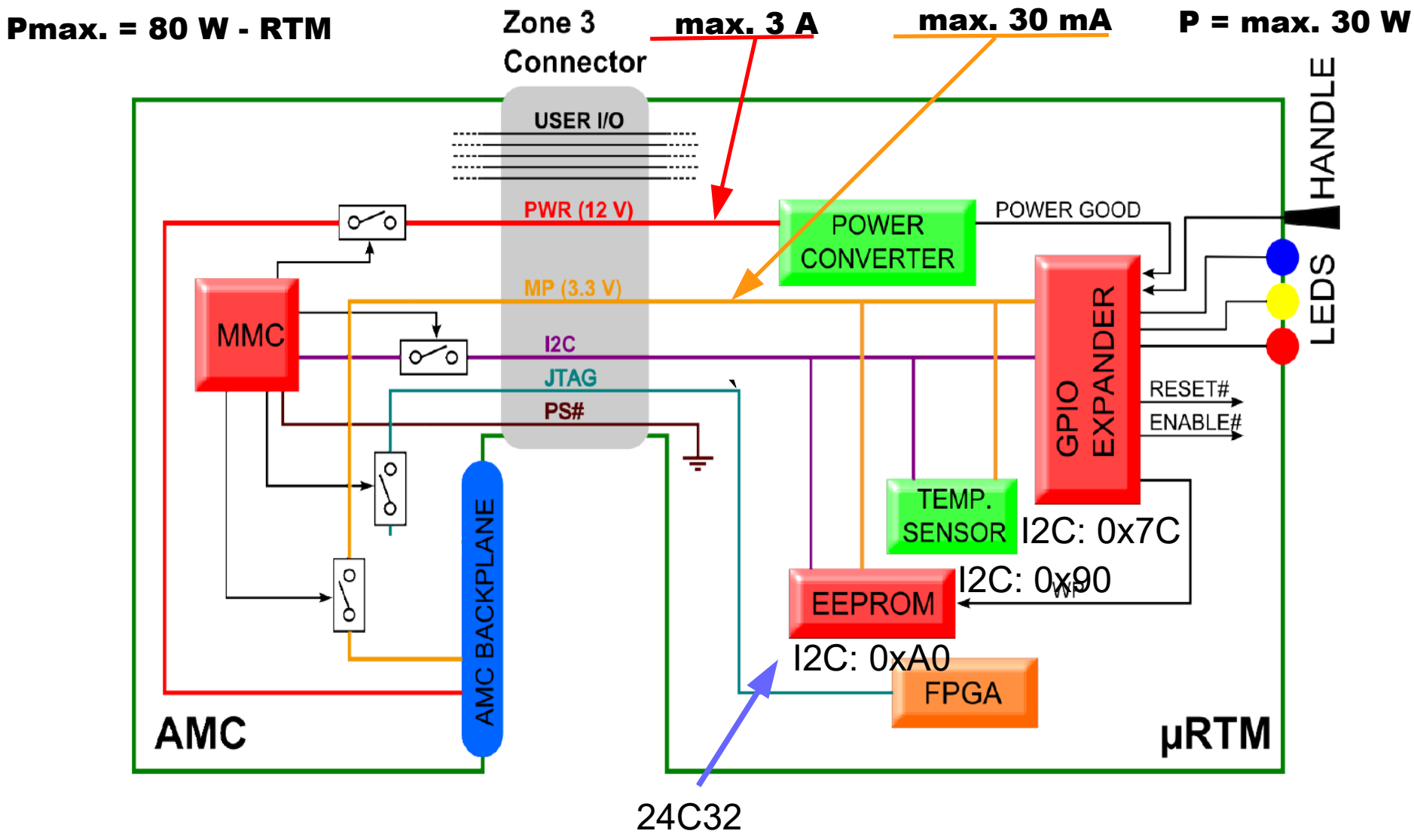
RTM Management Controller

RTM Management Controller

- Required on each RTM Module
- Simple and Advanced solution
- Communication with MMC
- RTM management:
  - Module activation and deactivation
  - Warm and cold module reset
  - Power supply management
- Monitoring of module crucial parameters
  - Temperature
  - Supply voltages
  - Currents
  - Clocks, etc.
- E-keying mechanism (Zone 3)



RTM Management – Simple Solution



MMC Firmware

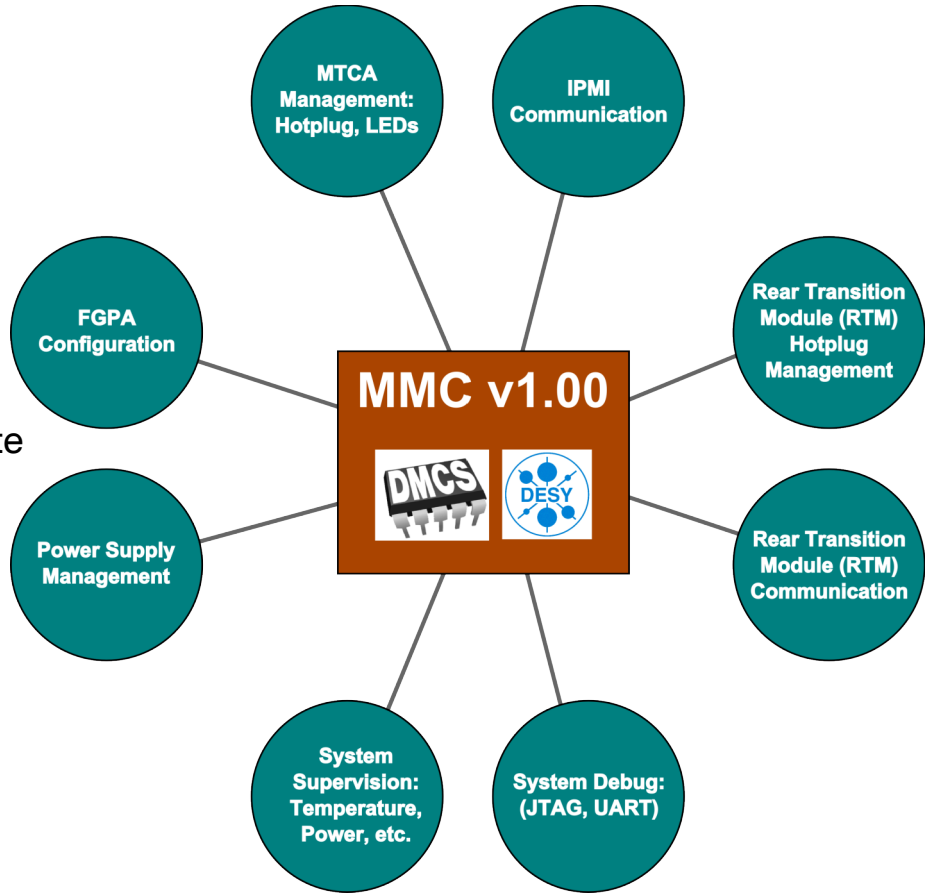
MMC Firmware (1)

MMC for AMC:

- Standard MTCA.4 compliant functions
- Monitoring of on-board voltages
- Protection in case of overheating
- UART for debugging and local monitoring
- Zone3 Isolation functionality
- Hot-plugging controller for µRTM Modules
- Management of on-board FPGA/CPU/DSP and firmware update
- MMC firmware upgrade using HPM.1

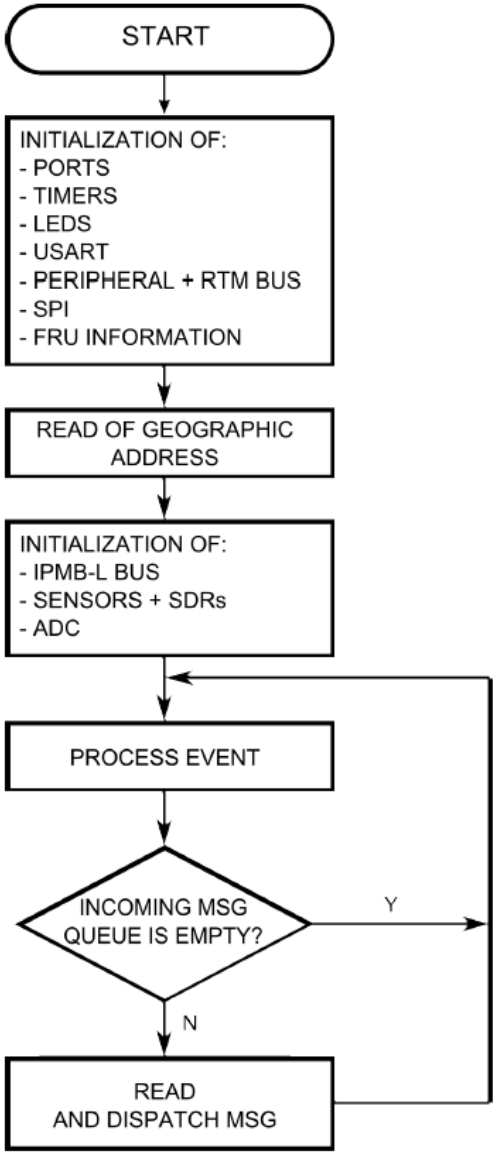
MMC for µRTM:

- Standard MTCA.4 compliant functions
- Monitoring of on-board voltages
- Protection in case of overheating
- UART for debugging and local monitoring
- Zone3 Isolation functionality
- Management of payload reconfiguration and firmware update



MMC – Implementation (1)

- Initialization
  - Initialization of software structures
  - Configuration of peripheral devices
- Main loop
  - Event processing
  - Messages handling
  - Updating sensors
  - Payload Control
  - Command Line Interface



MMC – Implementation (2)

- Works aimed to code portability
- Software layers

IPMI commands handling,
FRU and SDR structures
implementation,
message queues,

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built-in interfaces control,
interrupts handling

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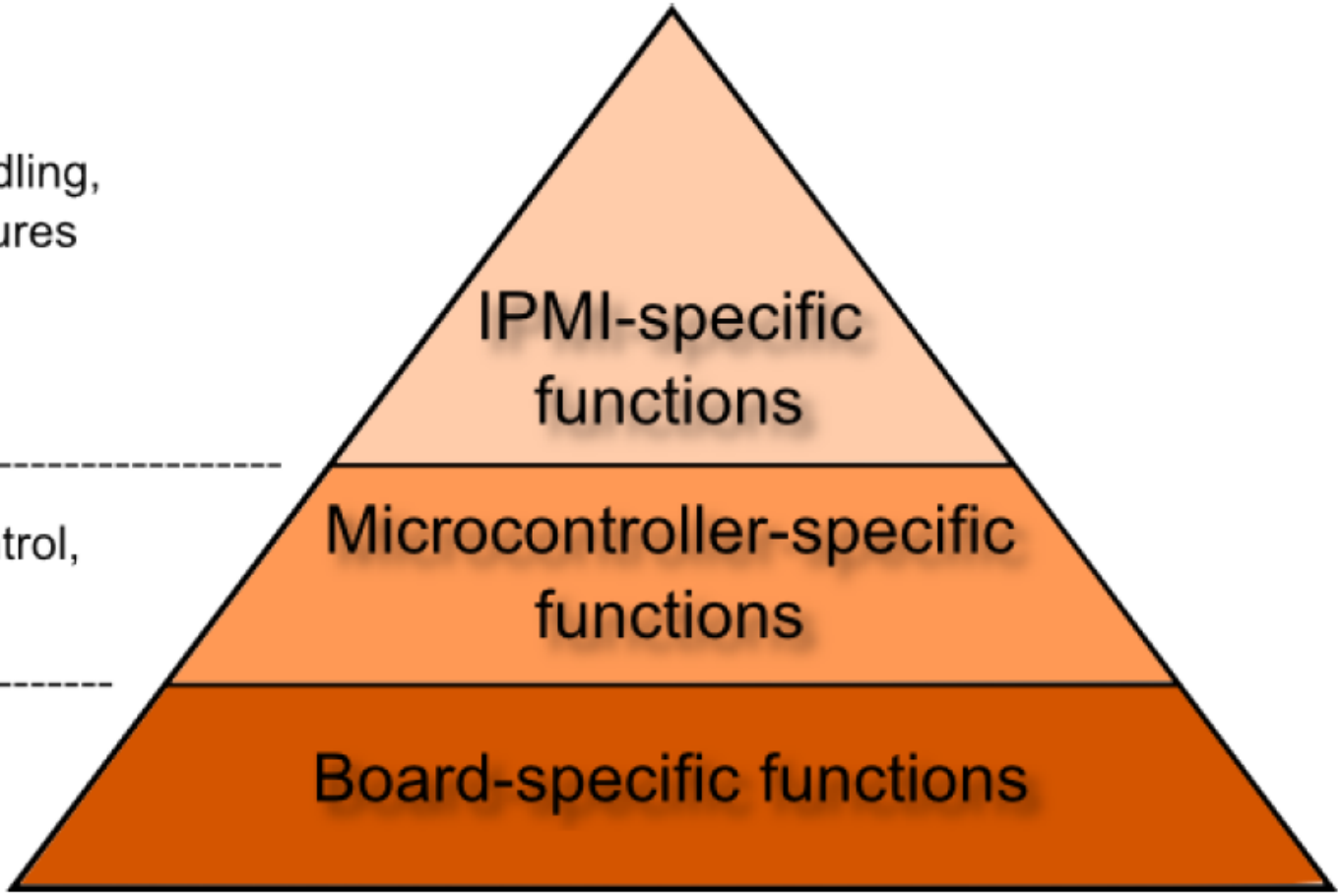
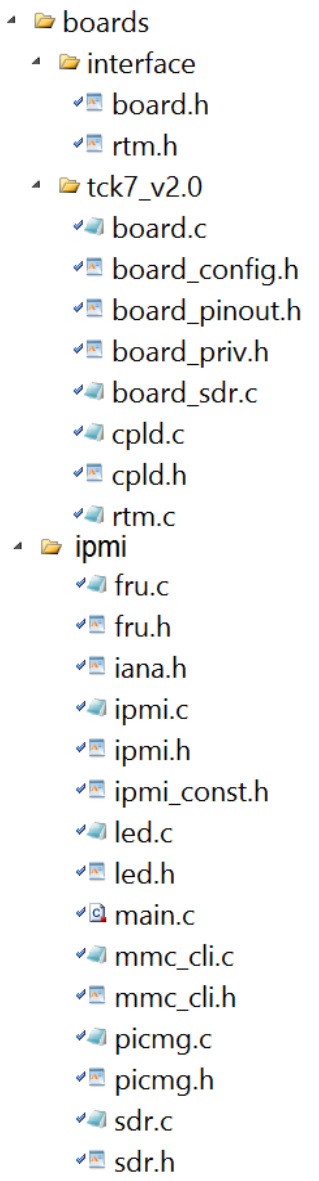
on-board devices
supervision,
sensors reading



MMC – Implementation (3)

- **IPMI core**
  - IPMI events service
  - SDR, FRU, LEDs
  - PICMG commands
  - RTM Manager
- **Microcontroller specific functions**
  - Drivers and services for microcontroller
  - Drivers for peripheral devices
  - Start-up code
- **Board specific functions**
  - Device drivers
  - Sensors
  - Payload management




```
* @file board.c
* @brief Board implementation of board specif
*
* @copyright (C) 2014 Deutsches Elektronen-S
* @copyright (C) 2014 Lodz University of Tech
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Thank you for your attention

Questions ?
Comments ?