

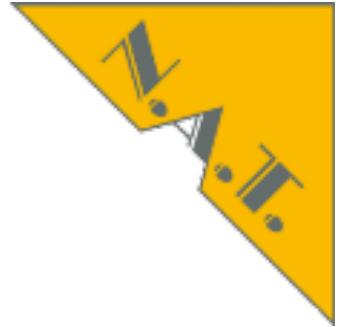
# Update MTCA.4

Vollrath Dirksen, vollrath@nateurope.com



Let Your **Application** benefit

[www.nateurope.com](http://www.nateurope.com)

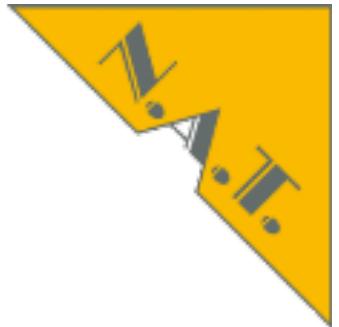


# MTCA.4 Update

## Agenda

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- Introduction N.A.T.
- History of MicroTCA and Comparison of Standards
- Markets of MicroTCA
- MTCA.0
- MTCA.4
- Upcoming MTCA.4.1 Standard
- New Trends in MTCA.4



# About N.A.T. Network and Automation Technology

- Founded in 1990, privately owned
- Hard- and Software design and manufacturing
- Focus on innovation in communication
- international and worldwide operations
- Headquarters

Konrad-Zuse-Platz 9  
53227 Bonn  
Germany



- Instructors:
  - Dipl. Ing. Vollrath Dirksen, vollrath@nateurope.com
  - Dipl. Phys. Heiko Körte, heiko@nateurope.com



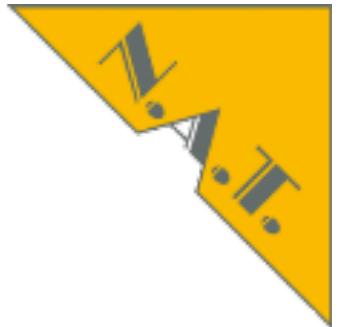


# About N.A.T.

Product Portfolio [www.nateurope.com](http://www.nateurope.com)

- **Board Level Products**
  - network interfaces, communication and processing boards
  - intelligent switches and system controllers
  - carriers, converters, adapters and extenders
- **Software**
  - board support packages, drivers
  - signaling stacks and protocols
  - applications and APIs
- **Systems**
  - pre-validated platforms for development and prototyping
  - turn-key solutions



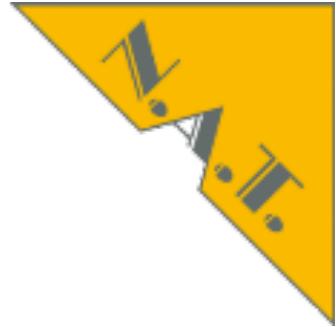


# MTCA.4 Update

## Agenda

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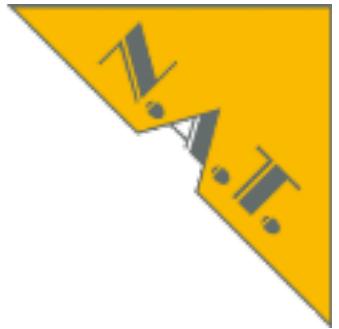
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# Comparison of Standards

## Differences in latest specs

	<b>VPX</b>	<b>ATCA</b>	<b>MTCA</b>
<b>Common size</b>	<b>3U, 6U</b>	<b>2U, 3U, 12U</b>	<b>1U, 2U, 3U, 5U, 9U</b>
<b>Backplane</b>	passive, switched	passive, switched	passive, switched
<b>topologies</b>	<b>single star, dual star (1/2 switch), full mesh, daisy-chain, ring</b>	<b>dual star, dual-dual star, full meshed</b>	<b>single star, dual star</b>
<b>profiles</b>	yes	no	no
<b>Voltages</b>	<b>MP: 3.3V PP: 3.3V, 5.0V, 12.0V optional: ±3.0V, ±12.0V</b>	<b>MP: 3.3V PP: 48.0V</b>	<b>MP: 3.3V PP: 12.0V</b>
<b>Slot budget (PP)</b>	115W@5V, 384W@12V 768W@48V	400W@48V	80W@12V
<b>Pins per slot</b>	<b>728 (6U), 168 (3U)</b>	<b>234/414</b>	<b>170 (AMC) 260(AMC+RTM)</b>
<b>Link speed (Gbaud)</b>	1.25, 2.5, 5, 6.25, 8.0	1.25, 2.5, 5, 6.25, 8.0	1.25, 2.5, 5, 6.25, 8.0
<b>Link width</b>	<b>x1, x2, x4, x8</b>	<b>x1, x2, x4, x8</b>	<b>x1, x2, x4, x8</b>
<b>Fabrics</b>	GbE, XAUI, PCIe, SRIO	GbE, <b>XAUFI</b> , PCIe, SRIO	GbE, XAUI, PCIe, SRIO
<b>Markets</b>	<b>Mil, Aerospace</b>	<b>Mil, Aerospace, core Net</b>	<b>all</b>

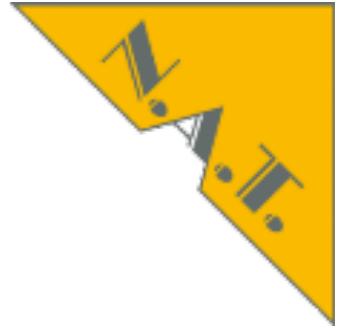


# Comparison of Standards

## Results

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- Results:
  - VPX targeting at one vertical market
    - ➡ limited volumes
    - ➡ industry develops for this market only
  - ATCA has its strength in bandwidth
    - ➡ limited use cases due to cost/function
- ➡ MTCA combines strengths and flexibility

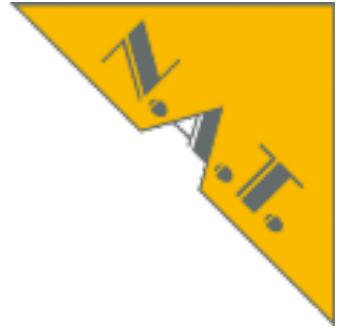


# Comparison of Standards

## Architectural features of MicroTCA - I/II

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- simple backplane architecture
  - ✓ reduces costs and risks, is re-useable in future
- all signals at same signal level (MLVDS)
  - ✓ no electrical clash
- switched connections
  - ✓ no blocking transfer
  - ✓ type of backplane connection depends on kind of switch
- all slots managed and controlled
  - ✓ detection of incompatibilities and faults
  - ✓ health management and fault isolation
  - ✓ hot-swap and hot-plug



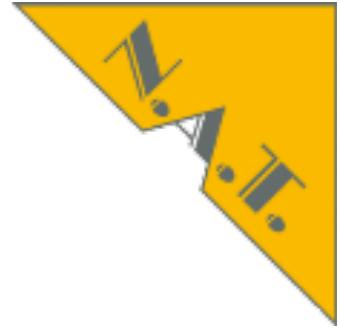
# Comparison of Standards

## Architectural features of MicroTCA - II/II

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- all data transfer are
  - independent
  - simultaneous
  - bidirectional
- data connections determined by one switch card:
  - **base/common options** fabric: GbE
  - **storage** fabric: SATA
  - **fat pipe** fabric: PCIe or XAUI or SRIO
  - **extended fat pipe** fabric: XAUI or SRIO

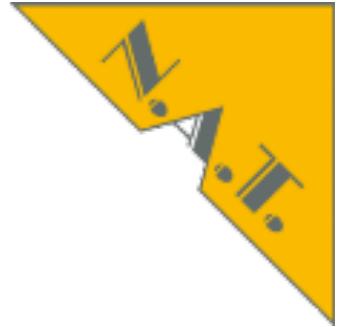
# Time to change to MicroTCA - User Statements



**DESY - Accelerator Control**  
**Lockheed Martin - Defence**  
**RUAG - Space**  
**GDP - Telemetry Network**  
**Varian - Medical**

<http://files.iccmedia.com/magazines/basapr15/basapr15.pdf>

The image shows the front cover of the April 02/15 issue of the magazine. The title 'boards & solutions + ECE' is at the top. Below it, the subtitle 'Combined Print Magazine for the European Embedded Market' and the date 'April 02/15'. The main headline 'Cover Story' is followed by 'MTCA – The proven successor for VME and CPCI'. The background features a stylized 3D map of Europe where the letters 'VME' and 'CPCI' are represented by landmasses and islands, with various icons like wind turbines, industrial buildings, and aircraft scattered across the continent. At the bottom left, there's a list of 'Special Features' including 'MicroTCA', 'Tools & Software', and 'Embedded Computing'. A call-to-action at the bottom right says 'Let Your Application benefit'.



# MTCA.4 Update

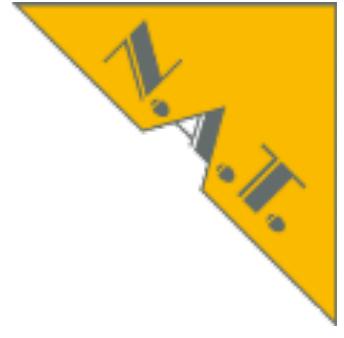
## Agenda

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# MicroTCA

## Markets

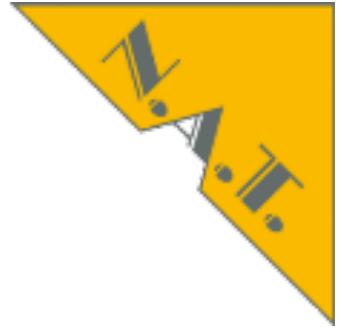


- 1 or 2 “big” standards in our work life
  - VME, PCI, cPCI ....
- MicroTCA and AMCs will be the next dominating standards for industrial systems
  - nothing real new but better and different
  - one standard meeting requirements of many different vertical markets



→ **MicroTCA is important already !**

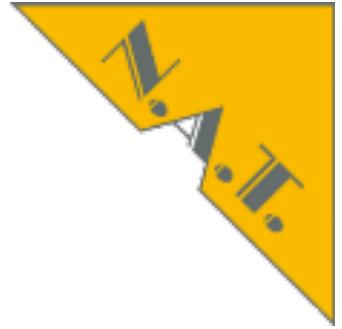
→ **MicroTCA will become even more important in the future !**



# Markets for MicroTCA

## Examples for Applications

- T&M
  - xxx: Network Sim&Test
  - xxx: Network test tool
  - xxx: LTE/LTE-A tester
- Mil&Aerospace
  - xxx: flight computer test
  - xxx: missile telemetry
  - xxx: inflight system
  - xxx: mission SDR
  - xxx: control and test
  - xxx: space
- Transportation
  - Inaswiss: Road Traffic Control
- Telecoms
  - xxx: LTE base station
  - xxx: mobile localization
  - xxx: lawful interception
  - xxx: satellite coms
- Medical
  - xxx: particle detection test
- Research
  - IHEP, SPring-8, DESY, SLAC, FRIB, CERN, STFC, GSI, ITER, CPNEM, LANL, PLS, AusLS



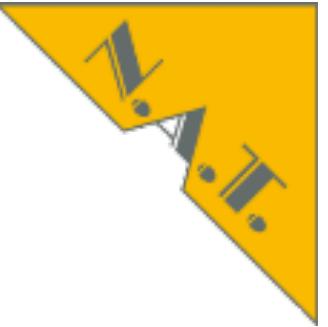
# MicroTCA - the standard

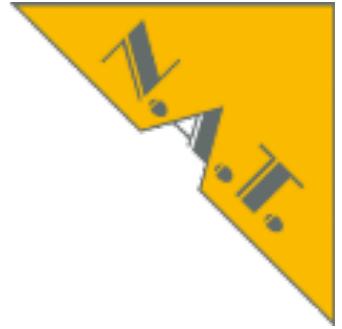
## Advanced Mezzanine Cards (AMCs)

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- AMC eco system
  - single and multi-core CPUs (Intel, Freescale, ARM, etc.)
  - single and multi-core PP and NPUs
  - line interfaces (E1/T1, SDH, ATM, 3G/4G/5G)
  - antenna interfaces
  - FPGAs (Xilinx, Altera, etc.)
  - DSPs (TI, Freescale, Octasic, etc.)
  - analogue and digital IO
  - industrial busses (EtherCAT, Profibus, CANbus etc.)
  - ADCs and DACs
  - SSD and HDD storage
  - GPUs

**It is time ... to change your  
Computing Platform!**





# MTCA.4 Update

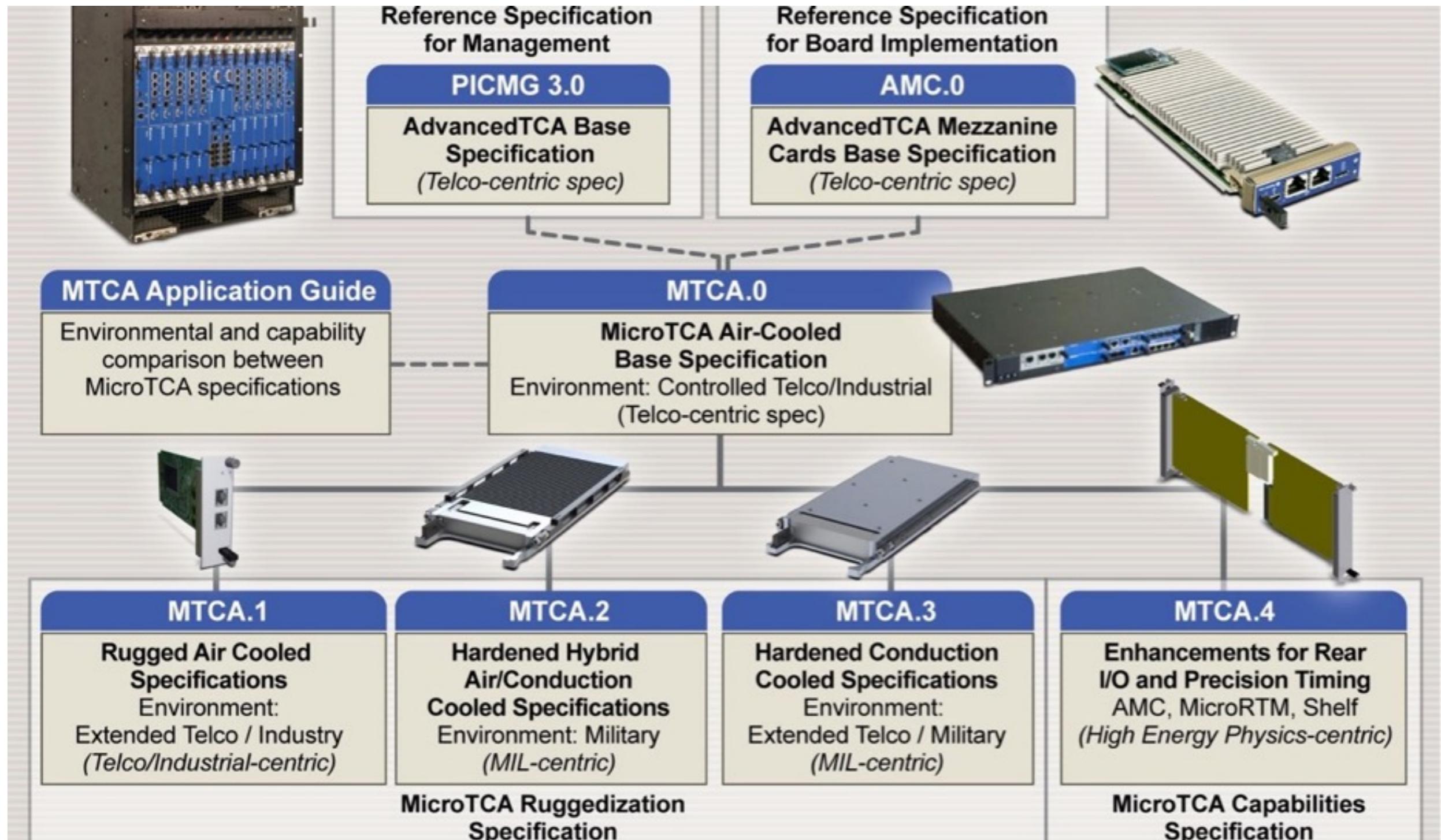
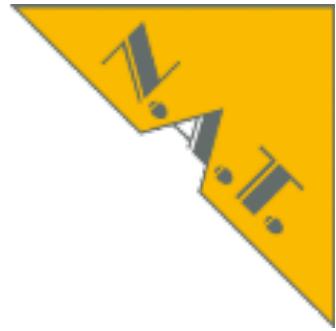
## Agenda

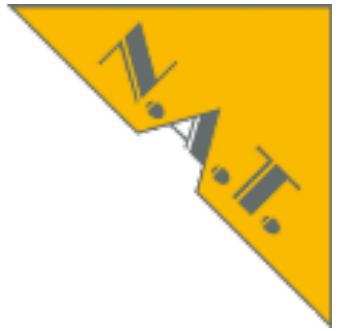
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# History of MicroTCA

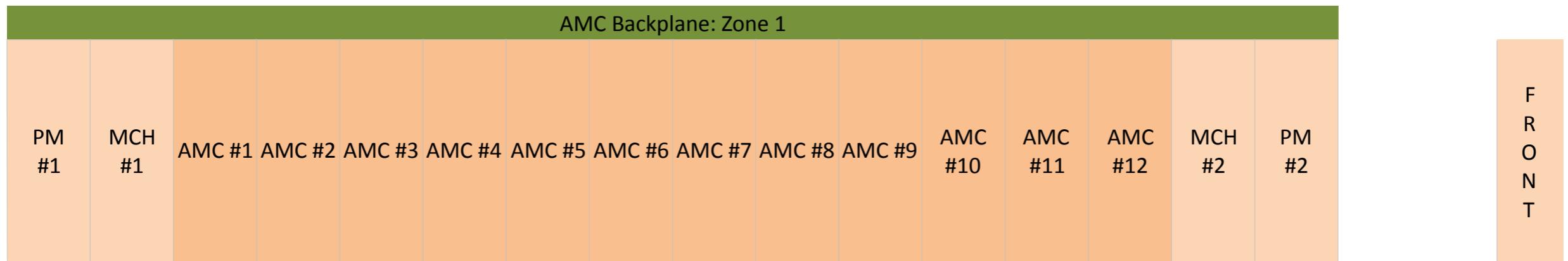
## Evolution from ATCA to MTCA





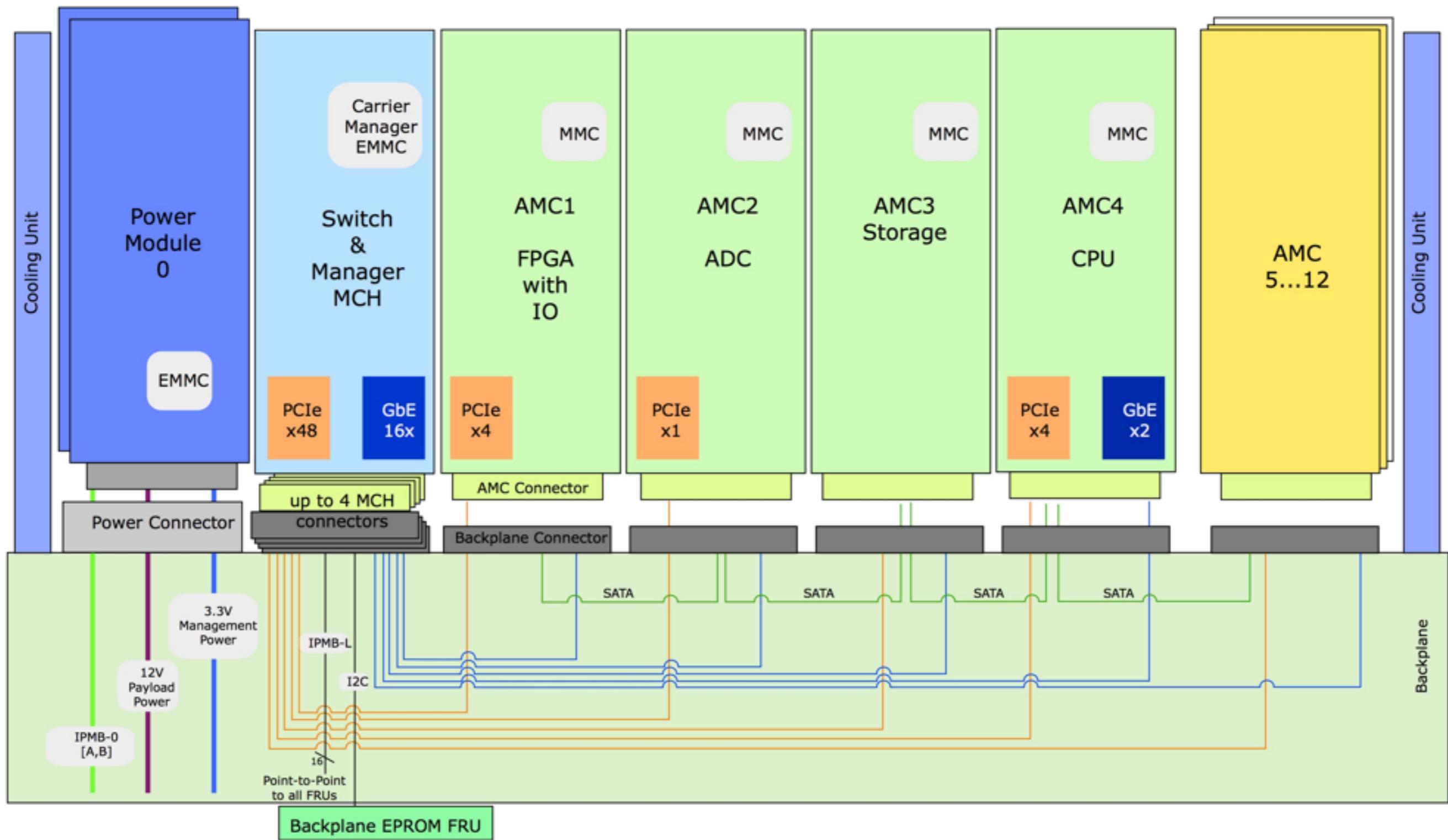
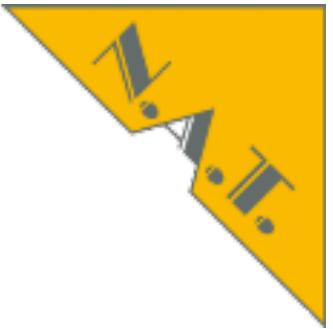
# MicroTCA - the standard

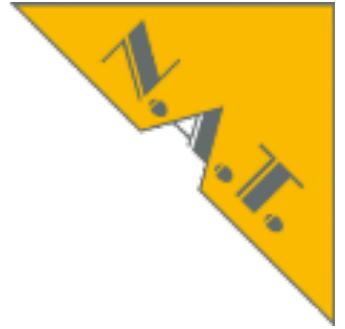
## MTCA.0 - no RTMs



Top-View of MTCA.0 System with MCH and PMs

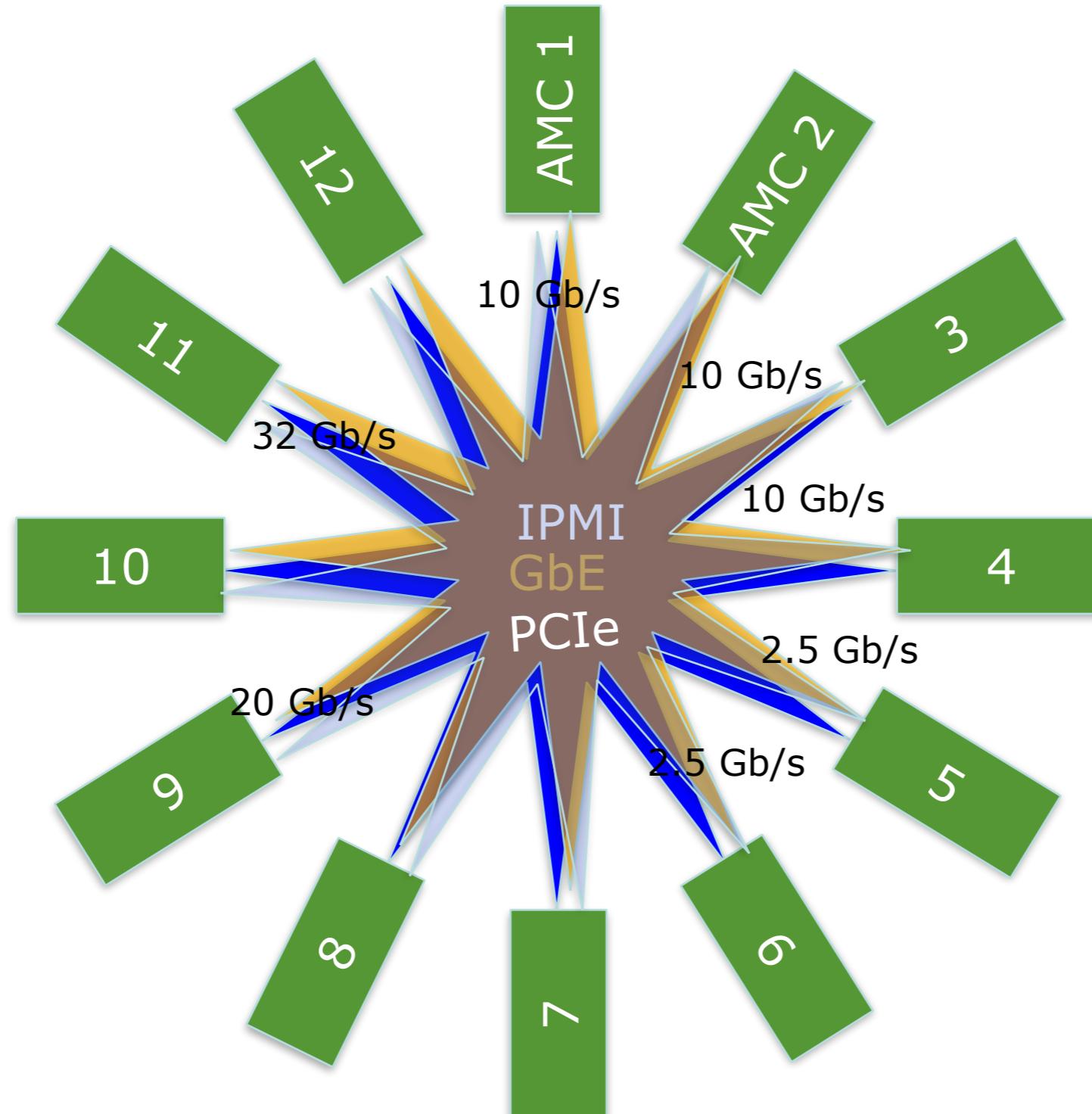
# MTCA.0

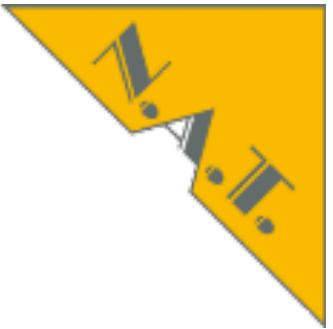




# MicroTCA - the standard

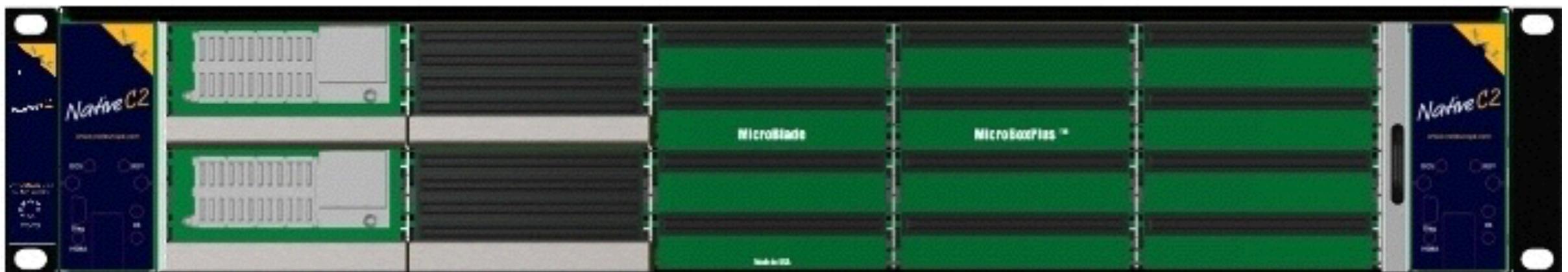
## Star topology - management and fabrics

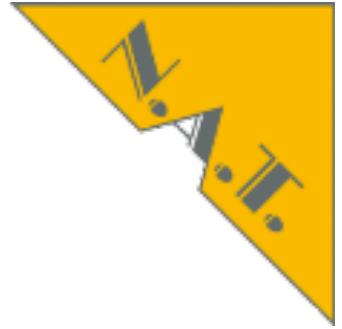




# MTCA.0

## Example: All components by N.A.T.



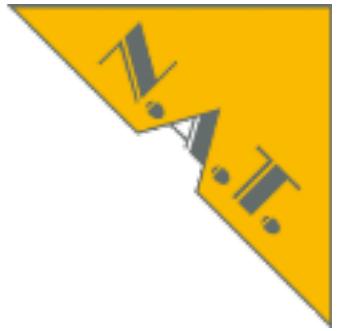


# MTCA.4 Update

## Agenda

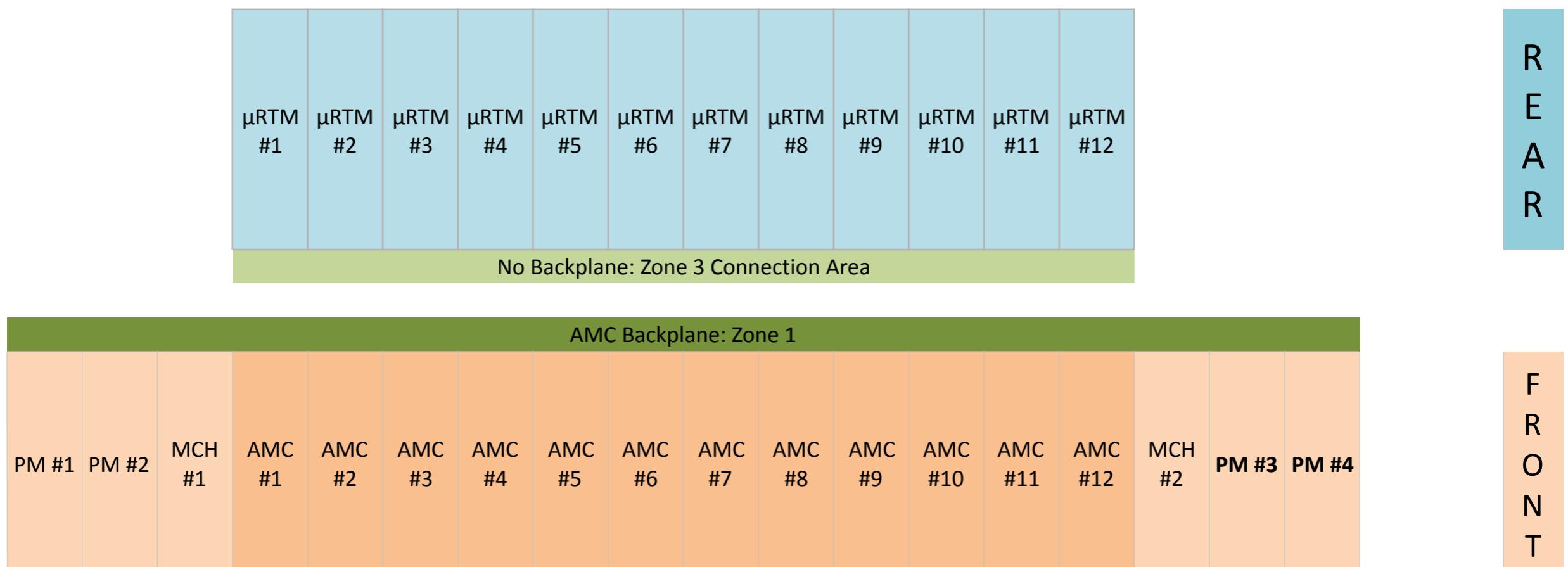
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# MicroTCA - the standard

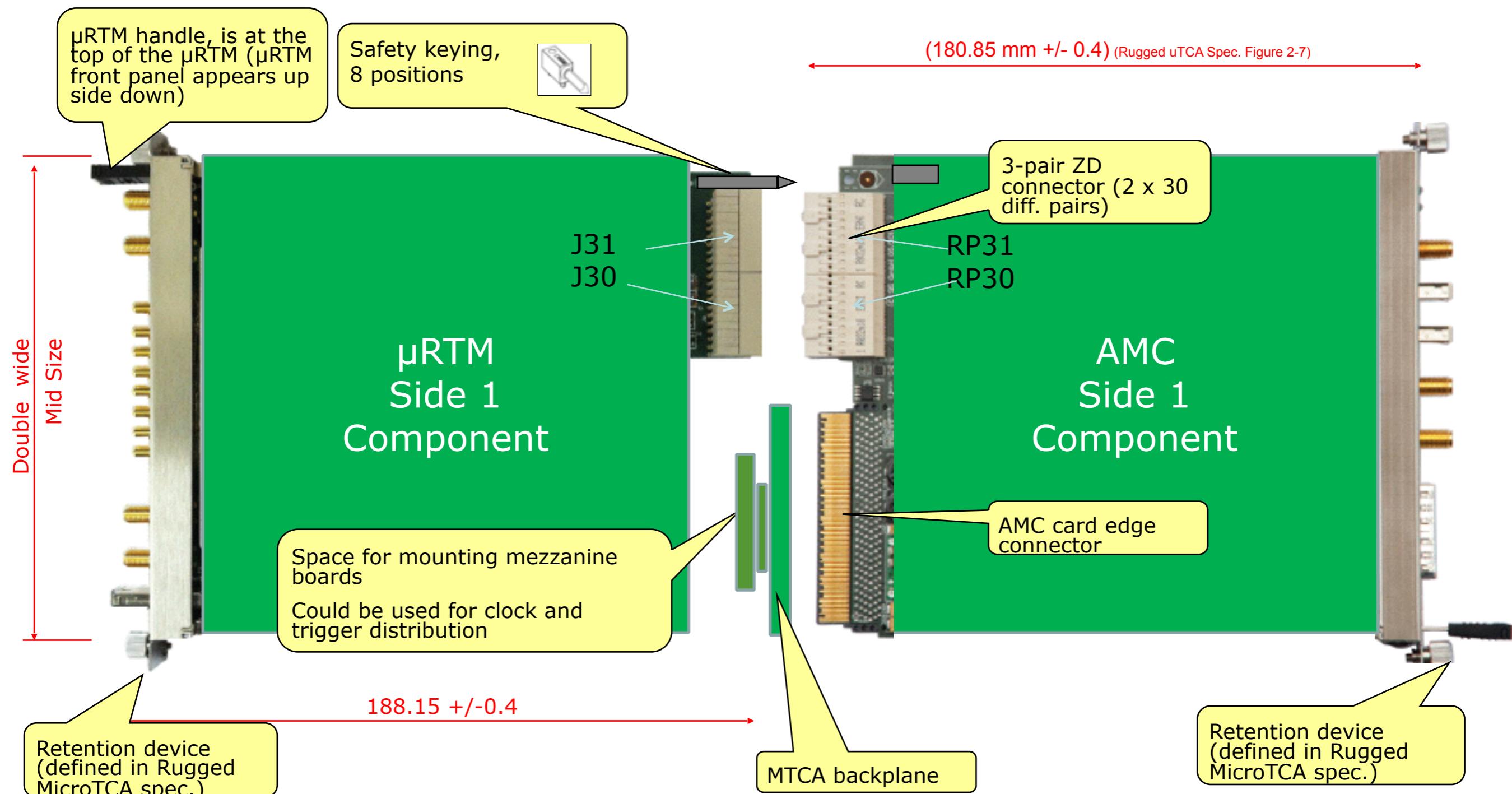
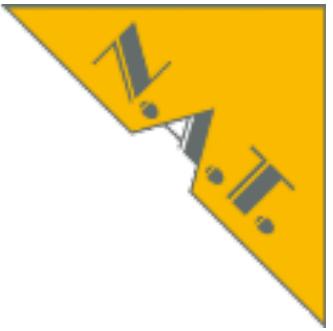
## MTCA.4 - adding μRTMs

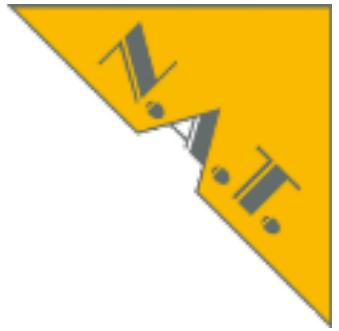


Top-View of MTCA.4 System with μRTM

# MTCA.4

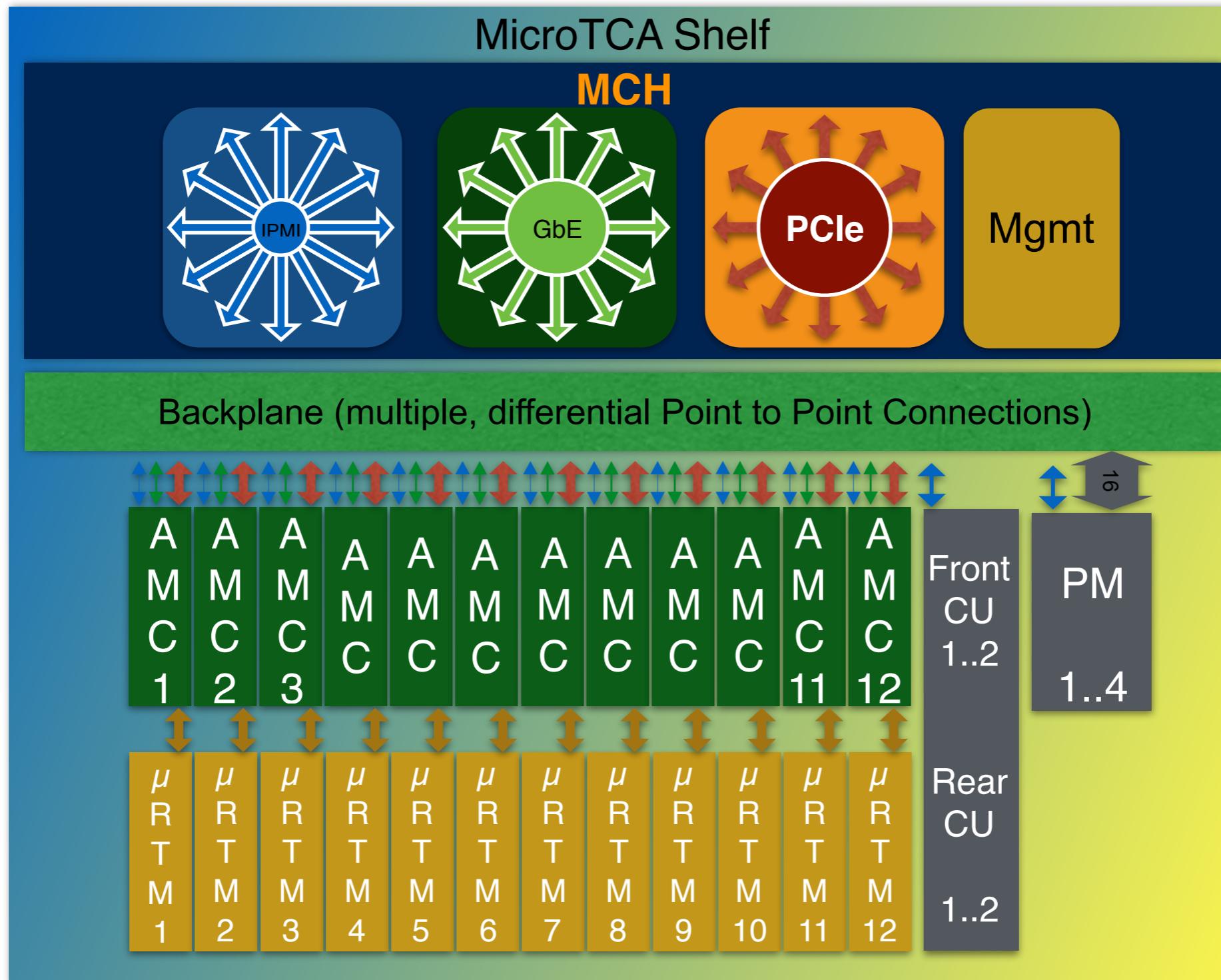
## AMC and μRTM

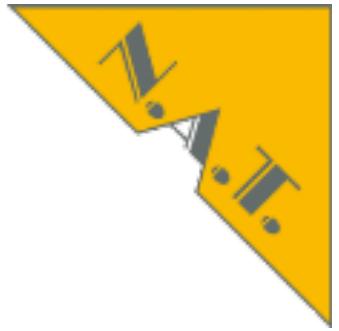




# MicroTCA - the standard

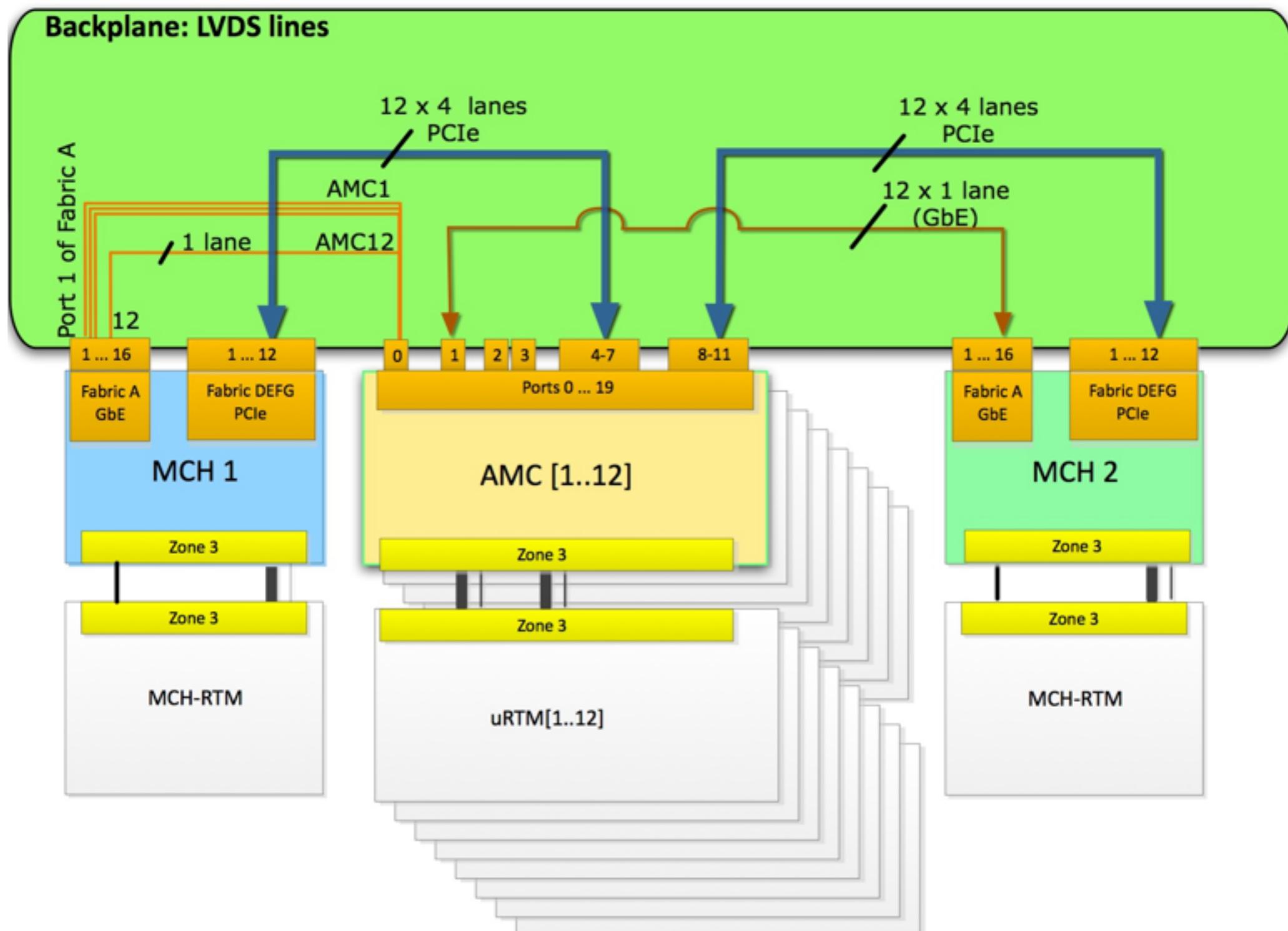
## MicroTCA Architecture: MTCA.x

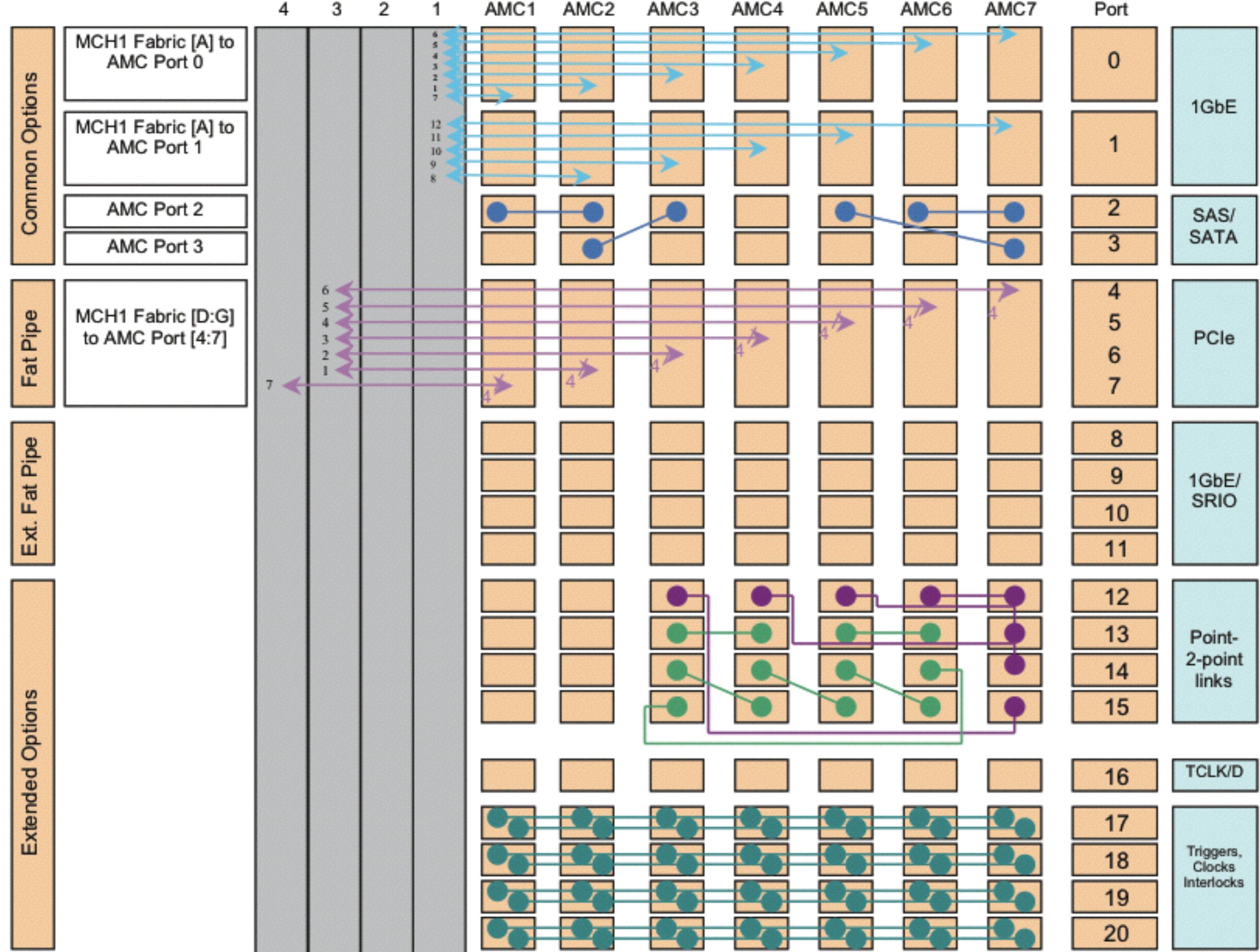


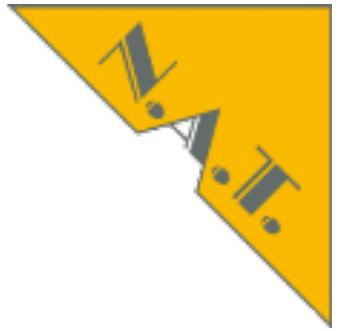


# MTCA: Redundant PCIe connections

## AMC needs local PCIe Clock







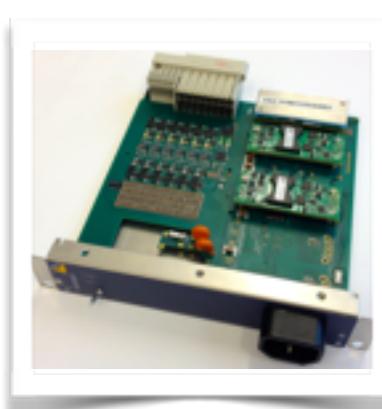
# Flexibility

## Power Supplies



### NAT-PM-

DC600LV DC420 DC840 AC600 AC600D AC1000



NAT-RPM-PSC



NAT-RPM-PSC + 100V

- NAT-PM-DC420 -48V DC 420W
- NAT-PM-DC840 -48V DC 840W
- NAT-PM-DC600LV +24V DC 600W
- NAT-PM-AC600 110-265V AC 600W
- NAT-PM-AC600D 110-265V AC 600W
- NAT-PM-AC1000 110-265V AC 1000W
- NAT-RPM-PSC 110-265V AC 600W
- +/- variable Voltages
- High Voltage Module

- AC power modules also for 90-265V AC
  - but with degradation of Watts

```
nat> show_pm
```

```
-----  
PM1: - online, primary(fru 50) : budget 50.0 A (alloc 23.5 A avail  
26.5 A)
```

```
PM2: - unknown
```

```
PM3: - unknown
```

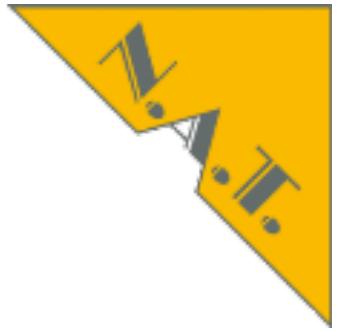
```
PM4: - unknown
```

chan	FRU	FruId	primPM	secPM	PS1	POn	ENA	MP	PP	Amps
1	MCH1	3	1	-	Y	Y	Y	Y	Y	5.5
2	MCH2	4	-	-						
3	CU1	40	1	-	Y	-	Y	Y	Y	4.5
4	CU2	41	-	-						
5	AMC1	5	1	-	-	-	-	-	-	
6	<b>AMC2</b>	<b>6</b>	<b>1</b>	-	<b>Y</b>	-	<b>Y</b>	<b>Y</b>	<b>Y</b>	<b>5.0</b>
7	AMC3	7	1	-	Y	-	Y	Y	-	OC
8	AMC4	8	1	-	Y	-	Y	Y	Y	4.0
9	AMC5	9	1	-	Y	-	Y	Y	Y	4.5
10	AMC6	10	1	-	Y	-	Y	Y	-	
11	AMC7	11	-	-						
12	AMC8	12	-	-						
13	AMC9	13	-	-						
14	AMC10	14	-	-						
15	AMC11	15	-	-						
16	AMC12	16	-	-						

```
nat> show_sensorinfo 50
```

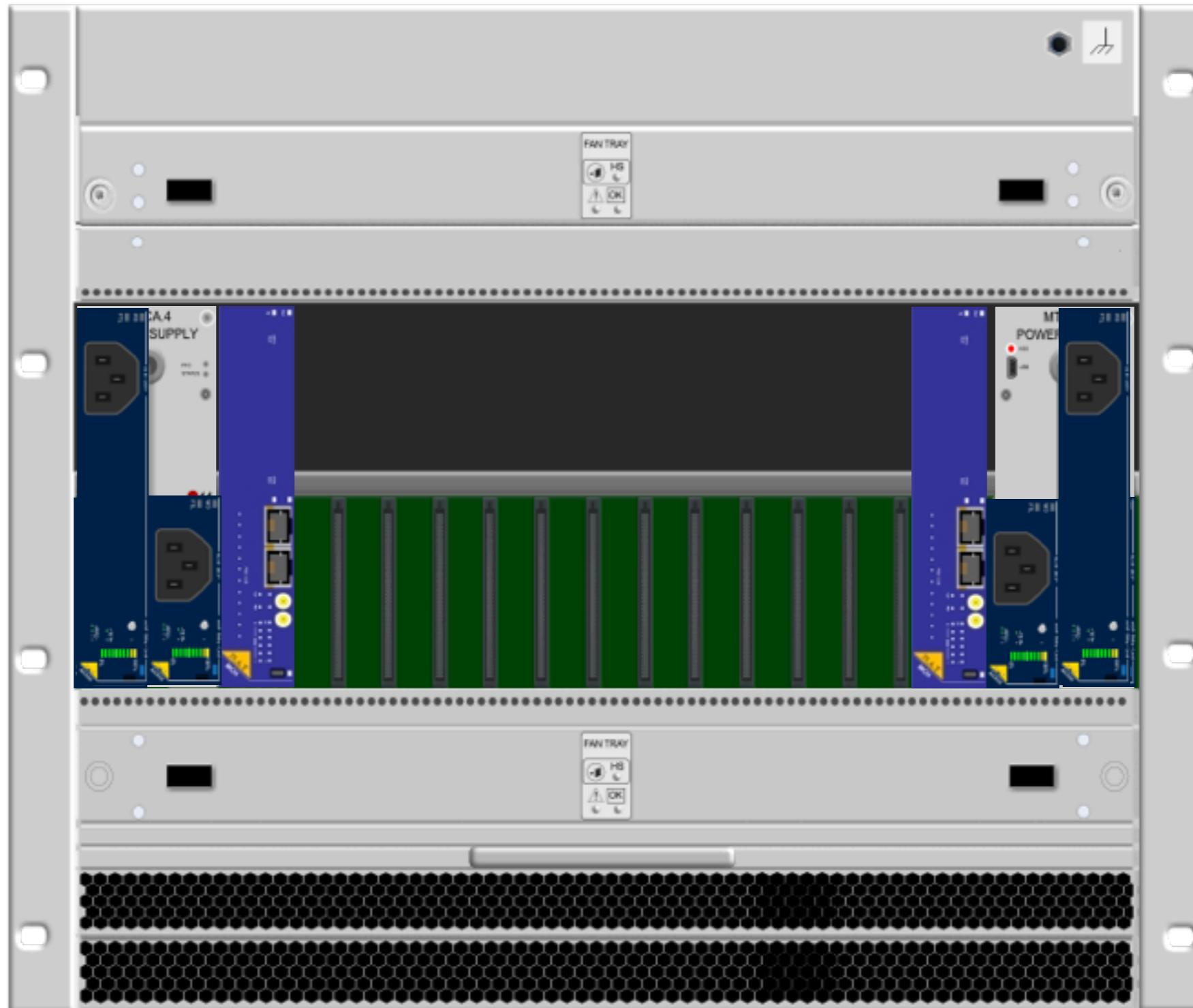
```
Sensor Information for FRU 50 / PM1
```

#	SDRTYPE	Sensor	Entity	Inst	Value	State	Name
30	MDevLoc		0x0a	0x61			<b>NAT-PM-AC600</b>
1	Full	Temp	0x0a	0x61	33 C	ok	T_CPU
2	Full	Temp	0x0a	0x61	48 C	ok	T_Xfrm
3	Full	Temp	0x0a	0x61	35 C	ok	T-PSB
4	Full	Temp	0x0a	0x61	54 C	ok	T-PFC1
5	Full	Temp	0x0a	0x61	49 C	ok	T-REC
6	Full	Voltage	0x0a	0x61	264 V	ok	VINAC
7	Full	Voltage	0x0a	0x61	444 V	ok	VINDC
8	Full	Voltage	0x0a	0x61	12.4 V	ok	12V
9	Full	Voltage	0x0a	0x61	3.4 V	ok	3.3V
10	Full	Current	0x0a	0x61	5.50 A	ok	I_Sum
11	Compact	Current	0x0a	0x61	2.20 A	ok	I_CH01
12	Compact	Current	0x0a	0x61	0.00 A	ok	I_CH02
13	Compact	Current	0x0a	0x61	0.50 A	ok	I_CH03
14	Compact	Current	0x0a	0x61	0.00 A	ok	I_CH04
15	Compact	Current	0x0a	0x61	0.00 A	ok	I_CH05
16	<b>Compact</b>	<b>Current</b>	<b>0x0a</b>	<b>0x61</b>	<b>2.20 A</b>	<b>ok</b>	<b>I_CH06</b>
17	Compact	Current	0x0a	0x61	0.00 A	ok	I_CH07
18	Compact	Current	0x0a	0x61	0.30 A	ok	I_CH08
19	Compact	Current	0x0a	0x61	0.30 A	ok	I_CH09
20	Compact	Current	0x0a	0x61	0.00 A	ok	I_CH10
21	Compact	Current	0x0a	0x61	0.00 A	ok	I_CH11



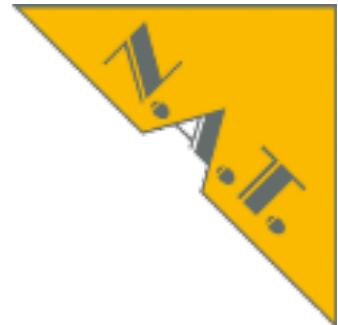
# Power Solutions

Power mgmt, redundancy, load sharing



# Easy Power Configuration

## NATview Power Configuration Manager



Fru Editor: FRU #253

Close window Read from file... Write to file... Write to FRU device... Power Configuration Manager...

Multi Record Area

- OEM Record - FRU Information Partition Record
- OEM Record - Carrier Manager IP Link Record
- OEM Record - MicroTCA Carrier Information Record
- OEM Record - MicroTCA Carrier Power Policy Record
  - Power Policy Descriptor 1
    - Power Channel Entry 1
    - Power Channel Entry 2
    - Power Channel Entry 3
    - Power Channel Entry 4

Field	Value	CodeType
Site Type	7 - AMC	Multiple Choice
Site Number	1	Decimal Integer
Power channel number	5	Decimal Integer
Maximum channel current	10000	Decimal Integer
Activation Control Flags		Decimal Integer
Delay Before Next Power On	1000	Decimal Integer
Deactivation control flags	1	Decimal Integer

Power Configuration Manager

Cancel Quit and Save

Status: OK

Power Channel: 1 MCH1 2 MCH2 3 CU1 4 CU2 5 AMC1 6 AMC2 7 AMC3 8 AMC4 9 AMC5 10 AMC6

Max. Power Output (mA): 10000 0 10000 0 10000 10000 10000 10000 10000 0

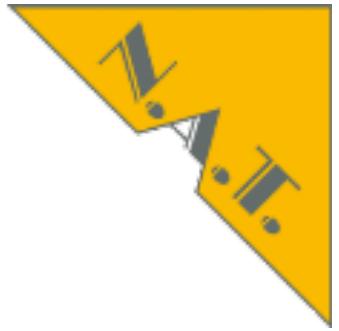
Required Power (mA): 300 n/a 200 n/a n/a n/a n/a n/a n/a n/a

PM enable

PH1 sum : 60000 mA  
max: 10000 mA  
primary (0)

PH2 sum : 0

A large orange arrow points from the 'Power Channel Entry 1' entry in the tree view to the '5 AMC1' row in the table. Another orange arrow points from the 'Power Channel Entry 1' row in the table to the '5 AMC1' row in the configuration manager interface below.



# Easy Power Configuration

## NATview Power Configuration Manager

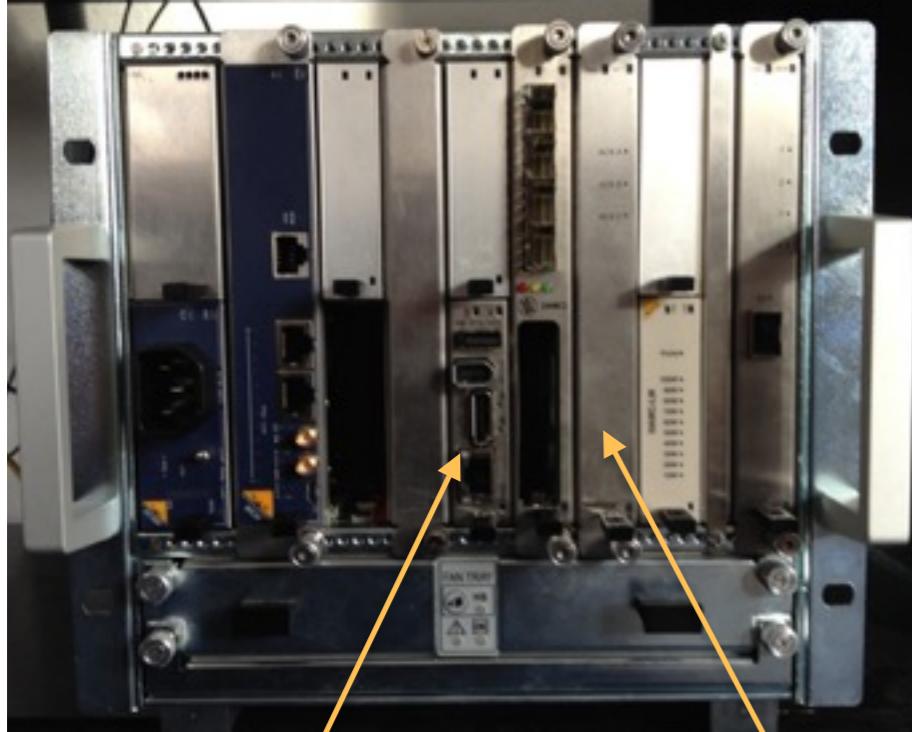
- Example: full redundancy, n+1 redundancy

Status: <span style="color: green;">OK</span>																		
PM enable	Power Channel:		1 MCH1	2 MCH2	3 CU1	4 CU2	5 AMC1	6 AMC2	7 AMC3	8 AMC4	9 AMC5	10 AMC6	11 AMC7	12 AMC8	13 AMC9	14 AMC10	15 AMC11	16 AMC12
	Max. Power Output (mA):		10000	0	10000	0	10000	10000	10000	10000	10000	0	0	0	0	0	0	
	Required Power (mA):		3500	n/a	2000	n/a	n/a	7200	n/a	2000	5000	n/a	n/a	n/a	n/a	n/a	n/a	
<b>PM1</b> sum : 70000 mA		<input checked="" type="checkbox"/>																
<b>PM2</b> sum : 70000 mA		<input checked="" type="checkbox"/>																
Status: <span style="color: green;">OK</span>																		
PM enable	Power Channel:		1 MCH1	2 MCH2	3 CU1	4 CU2	5 AMC1	6 AMC2	7 AMC3	8 AMC4	9 AMC5	10 AMC6	11 AMC7	12 AMC8	13 AMC9	14 AMC10	15 AMC11	16 AMC12
	Max. Power Output (mA):		10000	0	10000	0	10000	10000	10000	10000	10000	0	0	0	0	0	0	
	Required Power (mA):		3500	n/a	2000	n/a	n/a	7200	n/a	2000	5000	n/a	n/a	n/a	n/a	n/a	n/a	
<b>PM1</b> sum : 70000 mA		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<b>PM2</b> sum : 70000 mA		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<b>PM3</b> sum : 70000 mA		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>													
<b>PM4</b> sum : 70000 mA		<input checked="" type="checkbox"/>																



# MTCA.4: single & double AMCs

XFEL in Hamburg: extremely intense X-ray flashes



single

double



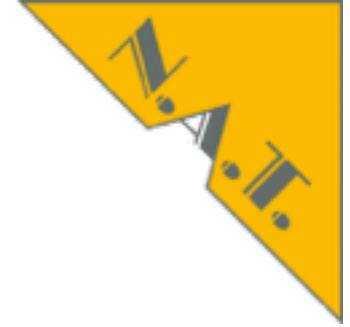
>200 systems  
365 days x 24 hours  
3.4 km  
pico second timing precision

# Market MTCA.4

## Status Update

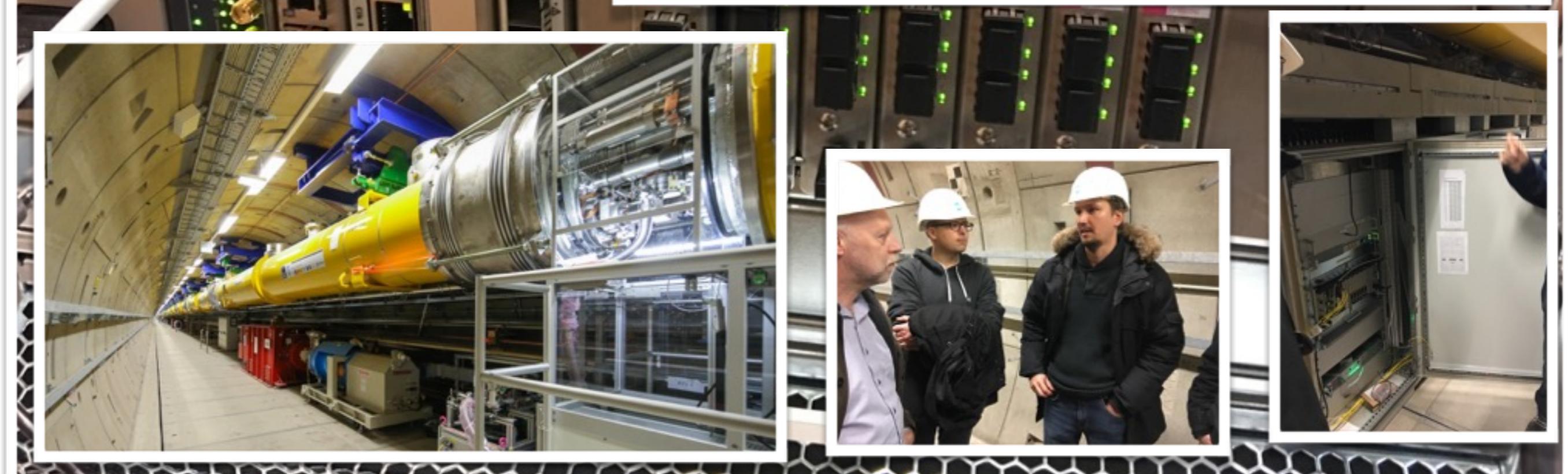
Vollrath Dirksen  
Update on MTCA.4

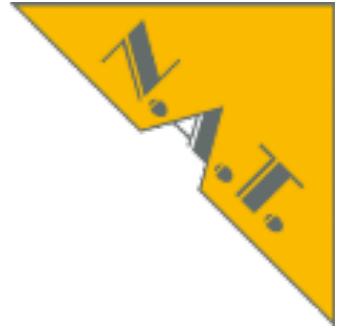
*In2p3 June 2016*



- DESY: FLASH, XFEL, Petra
  - XFEL key components:
    - NAT-MCH-PHYS (2/3) and NAT-MCH-PHYS80 (1/3)
    - AM900, multiple SIS8300, DAMC2, DAMC-TCK7, x2Timer, multiple RTMs
    - ongoing upgrade of older systems from VME to MTCA.4
- ESS, SPring8, ALS, BLS, IHEP, ELI-Beamlines, CRYRING@ESR
- CERN
  - CMS
  - Beamforming
- GSI - new FAIR project
- Plasma Reactor
  - Iter, KSTAR
- Trend at MTCA Workshop (Dec.-2015) and SEI Congress (Apr-2016)
  - Presenter stated clearly, that they need to look at MTCA.4, if they use older or different standard
  - Even proprietary solutions (due to price) are discussed be transferred to MTCA.4

## N.A.T. at and in DESY XFEL



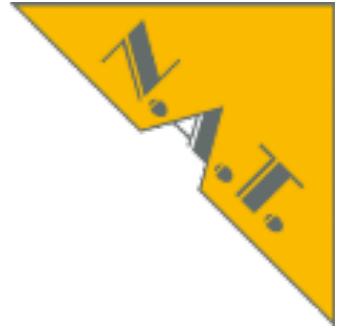


# MTCA.4 Update

## Agenda

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- Introduction N.A.T.
- History of MicroTCA and Comparison of Standards
- Markets of MicroTCA
- MTCA.0
- MTCA.4
- Upcoming MTCA.4.1 Standard
- New Trends in MTCA.4



# Motivation

## Need of μRTM backplane in MicroTCA.4

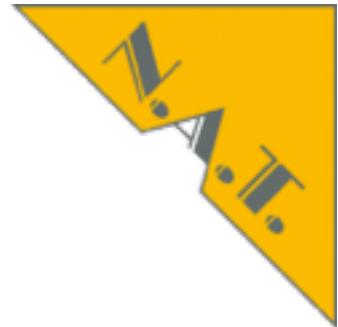
---

- Save the space for an extra chassis
- Save all the interconnection RF cable between the standard MTCA chassis and the RF chassis
- Integration into the standard MTCA backplane is not possible due to the special requirements of RF signal quality and separate power lines with different values than 12 V
- Standardize only μRTM backplane allowing users to add other functionality instead of RF signals to MicroTCA.4, i.e. only extra power
- fill the empty places in MTCA.4 behind MCH and Power Supplies
- Increase Bandwidth

# Upcoming MTCA.4.1 MicroTCA.4 Enhancements

Vollrath Dirksen  
Update on MTCA.4

*In2p3 June 2016*



- Auxiliary Backplane for Rear Transition Modules
  - ( $\mu$ RTMs & MCH RTM)
- Rear Power Modules (RPMs)

Class A1:

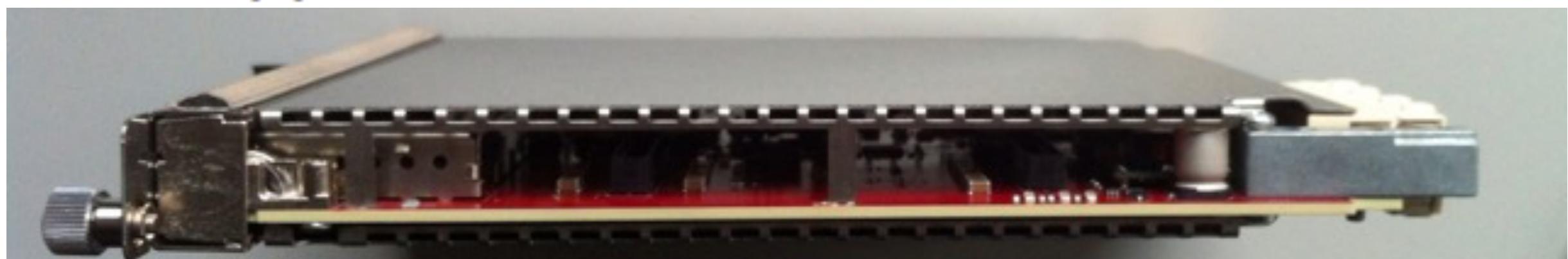
Pin Assignment for original mixed Analog Applications.

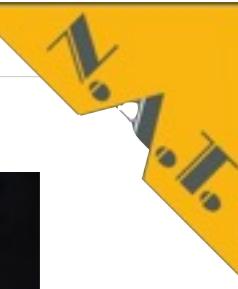
Class A1.1:

Pin Assignment Recommendations optimized for Analog Applications

Class A2.1:

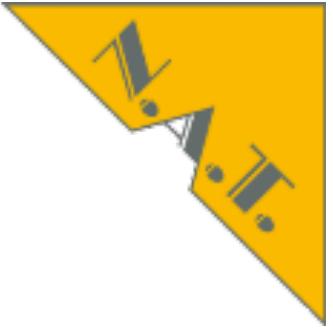
Pin Assignment Recommendations for Analog Applications with a high number of analog signals



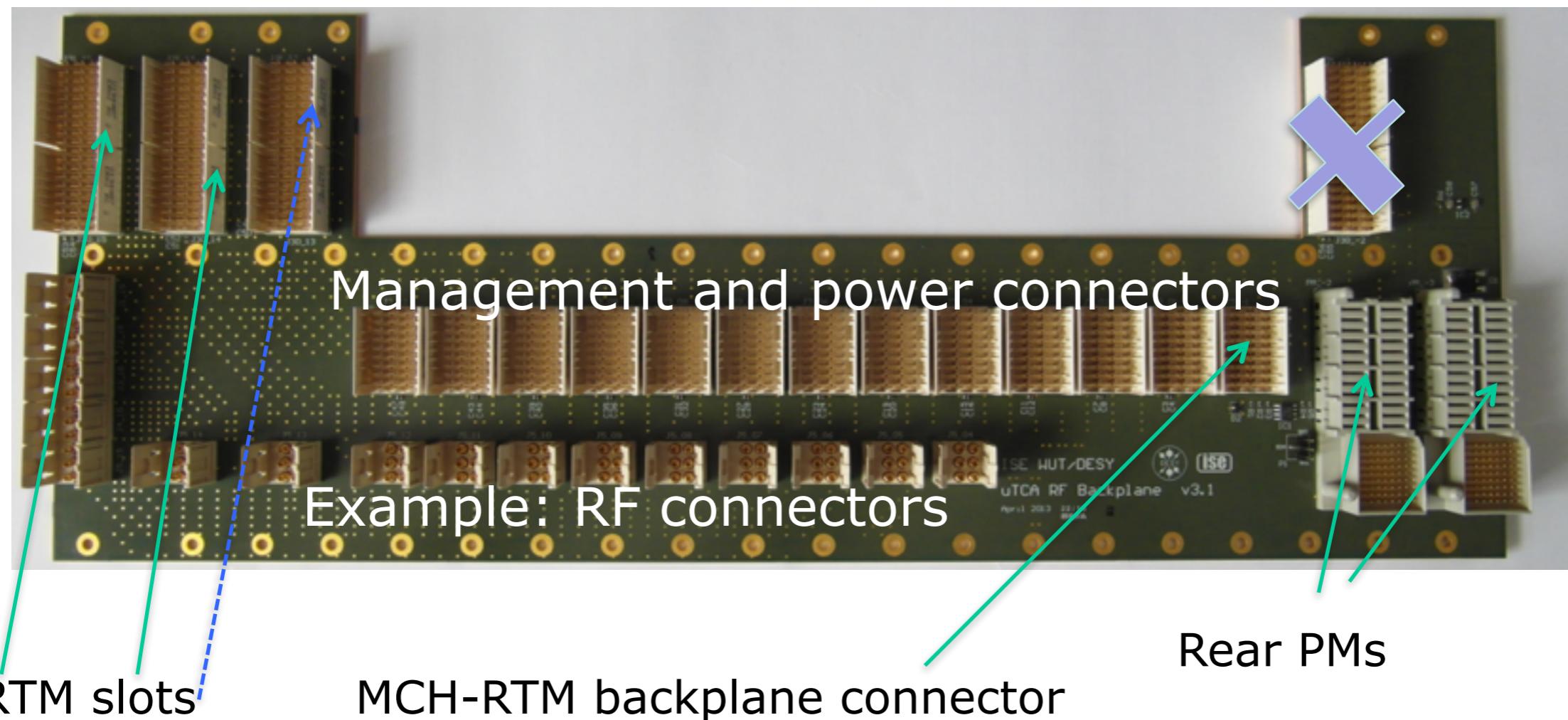
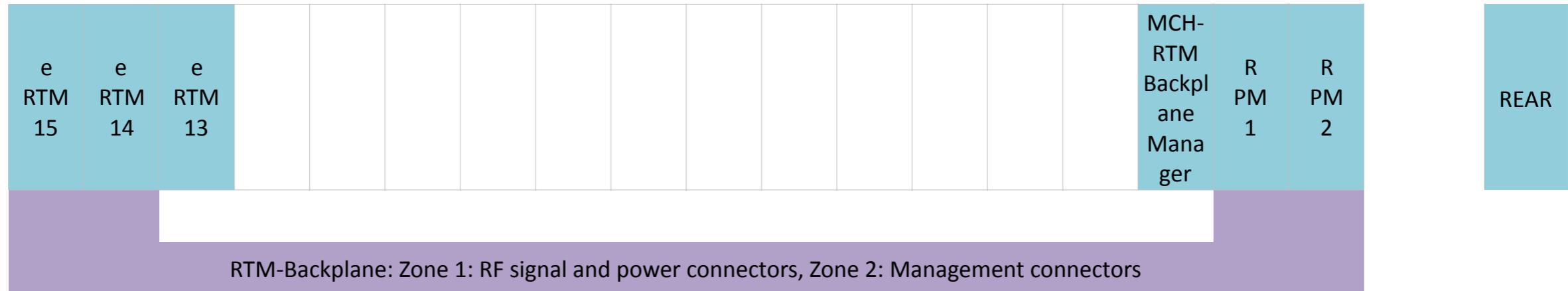


■ NAMC-psTimer-Cover





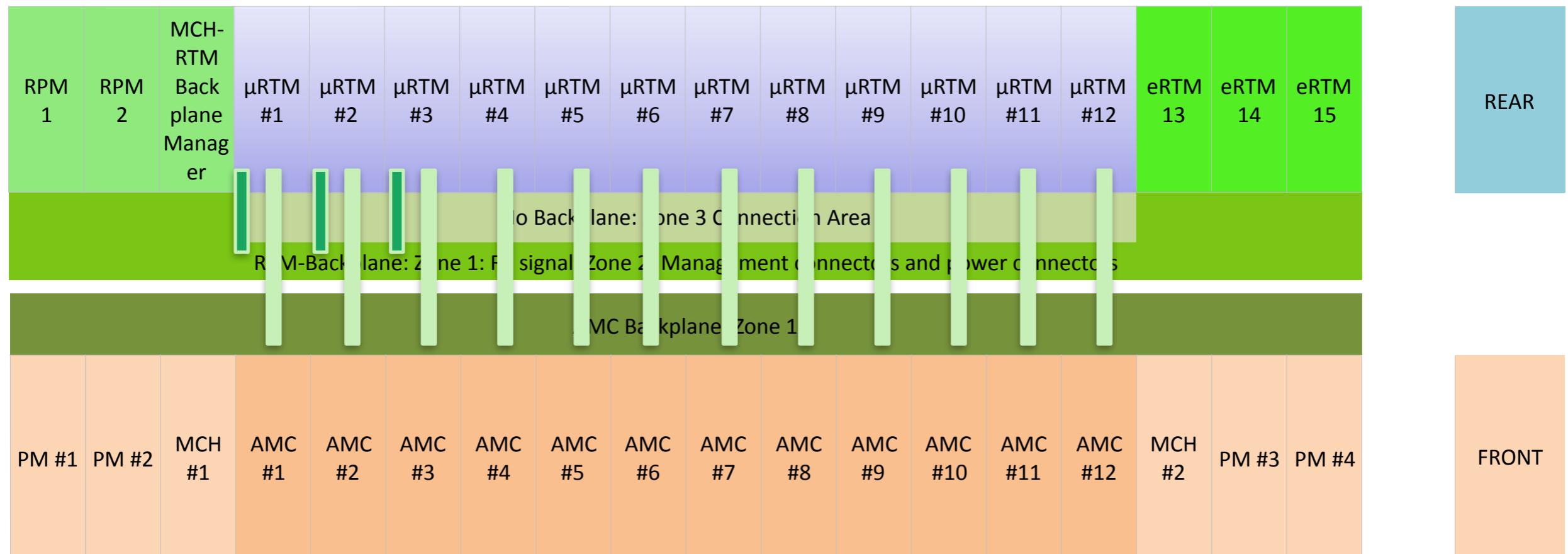
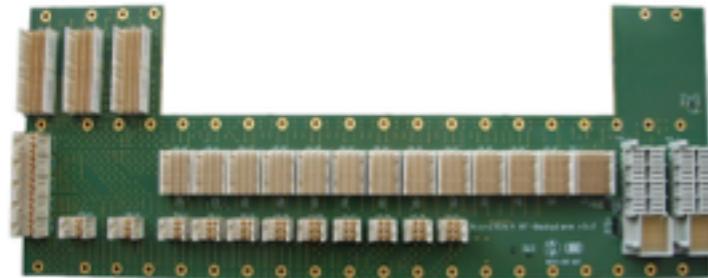
# Next Extension of MTCA.4: Adding μRTM Backplane



# MTCA.4 μRTM Backplane: Status: Commercial Available

Vollrath Dirksen  
Update on MTCA.4

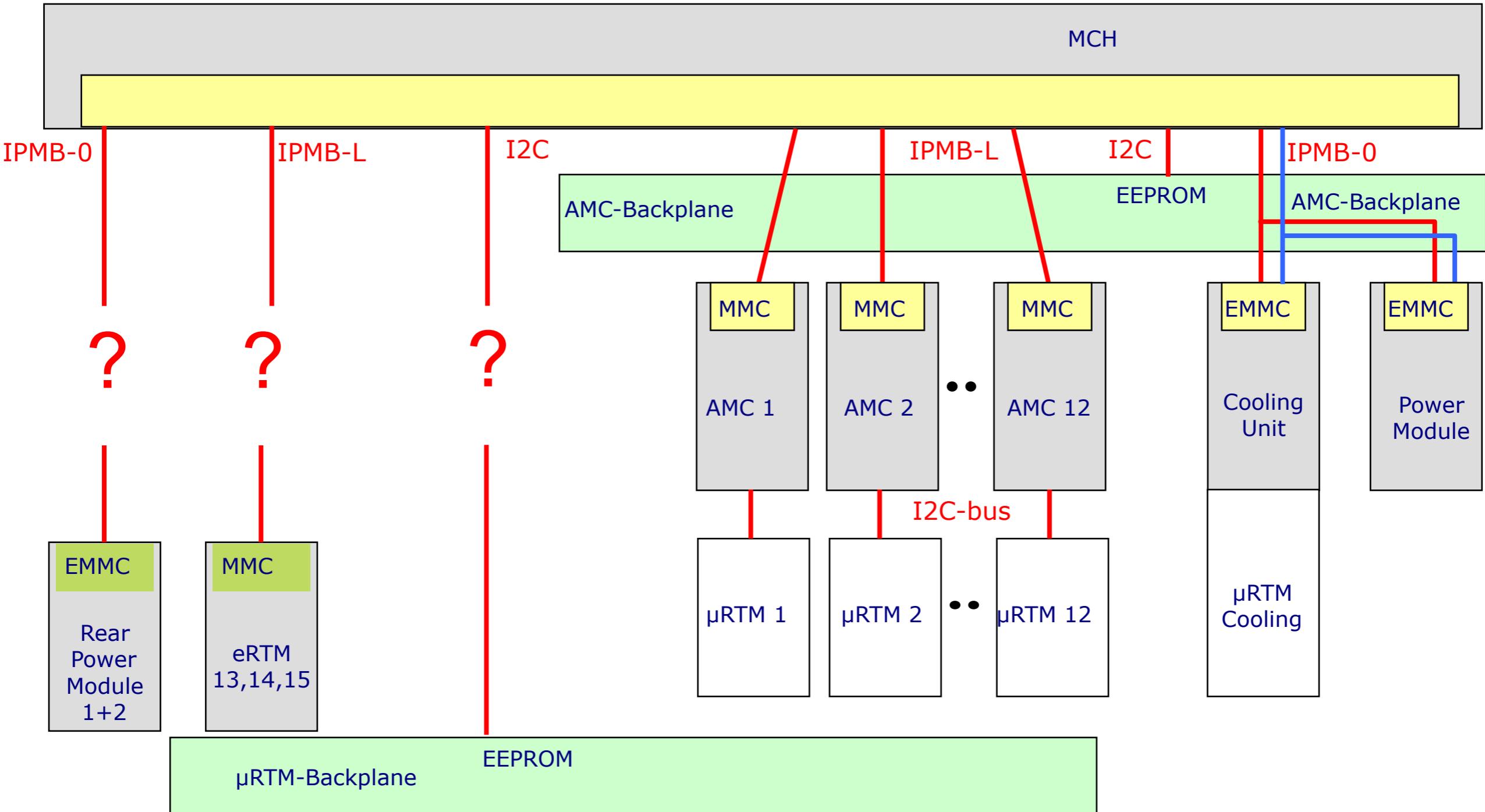
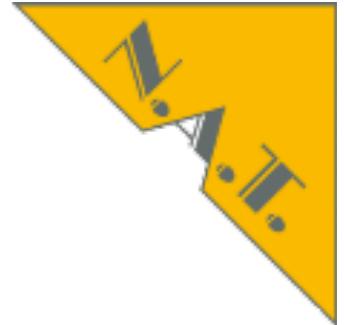
In2p3 June 2016



Top-View of MTCA.4 System with additional RTM Backplane, Rear Power Modules, MCH-RTM and optional eRTMs



# MCH Firmware Extension RPM, eRTM, $\mu$ RTM Backplane

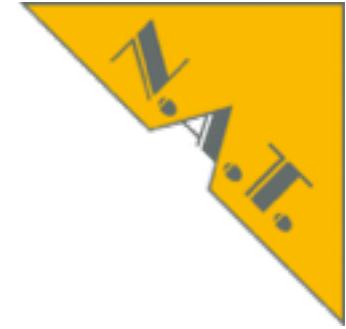


# Zone-3 and Zone-2 Signals

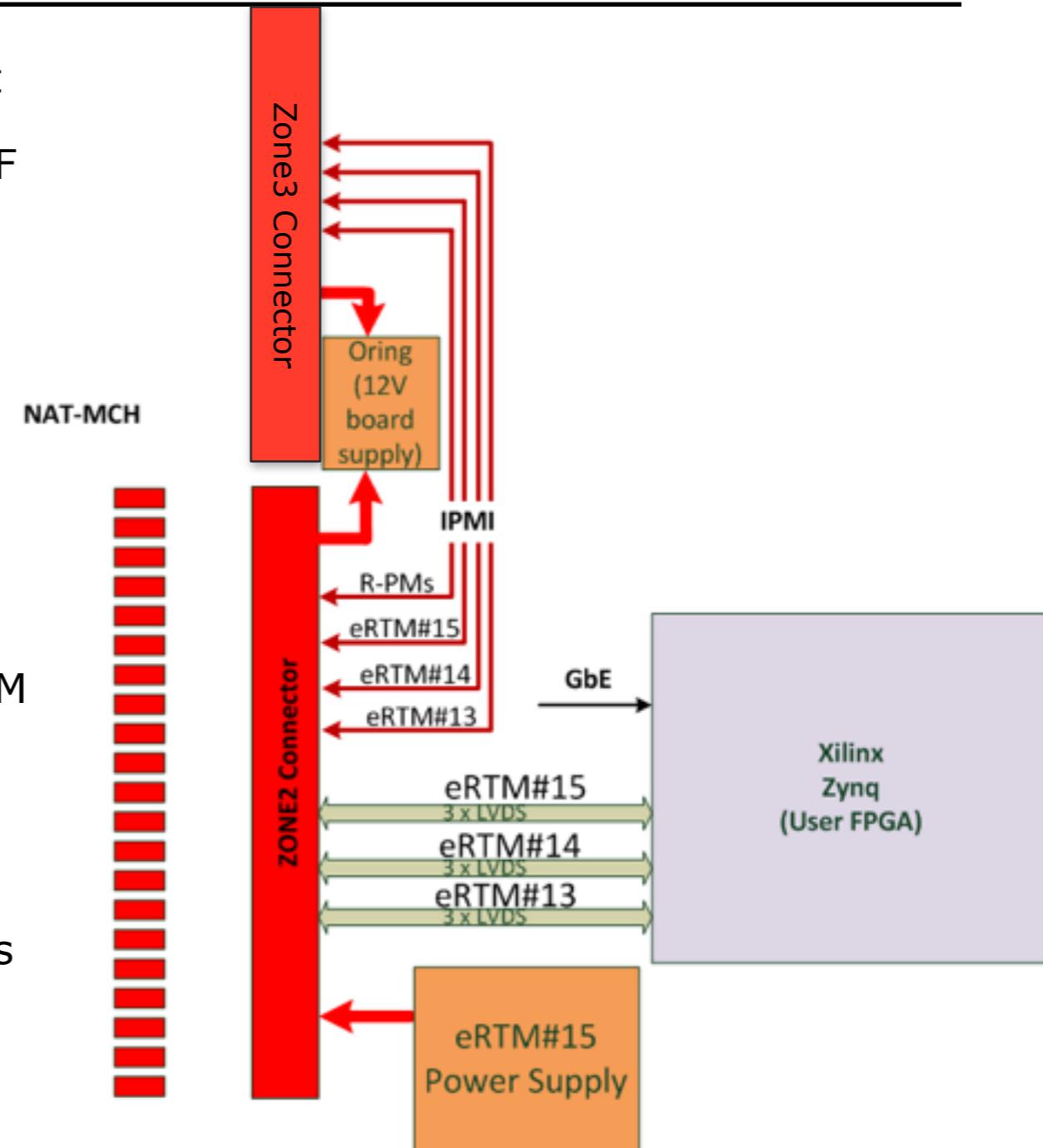
## Interconnection MCH + MCH-RTM + μRTM backplane

Vollrath Dirksen  
Update on MTCA.4

*In2p3 June 2016*



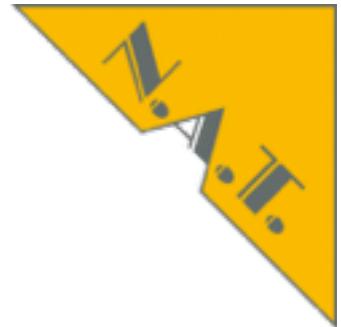
- Zone3 of MCH and RTM connector have to support
  - control of μRTM-Backplane for example RTM-RF
    - IPMB-L for eRTM13,14,15
    - IPMI-0 for Rear Power Module (RPM)
    - I2C for μRTM Backplane FRU device
  - Optional:
    - Power for eRTM15 if no RPM available
    - Standard μRTM pins: JTAG, MP, PP for MCH-RTM
    - Optional Pins: SPI, PCIe, GbE, SATA
- Zone2 connector
  - IPMB-L for eRTM13,14,15 and IPMI-0 for RPMs
  - I2C for μRTM-Backplane
  - power for eRTM15
  - Data bus



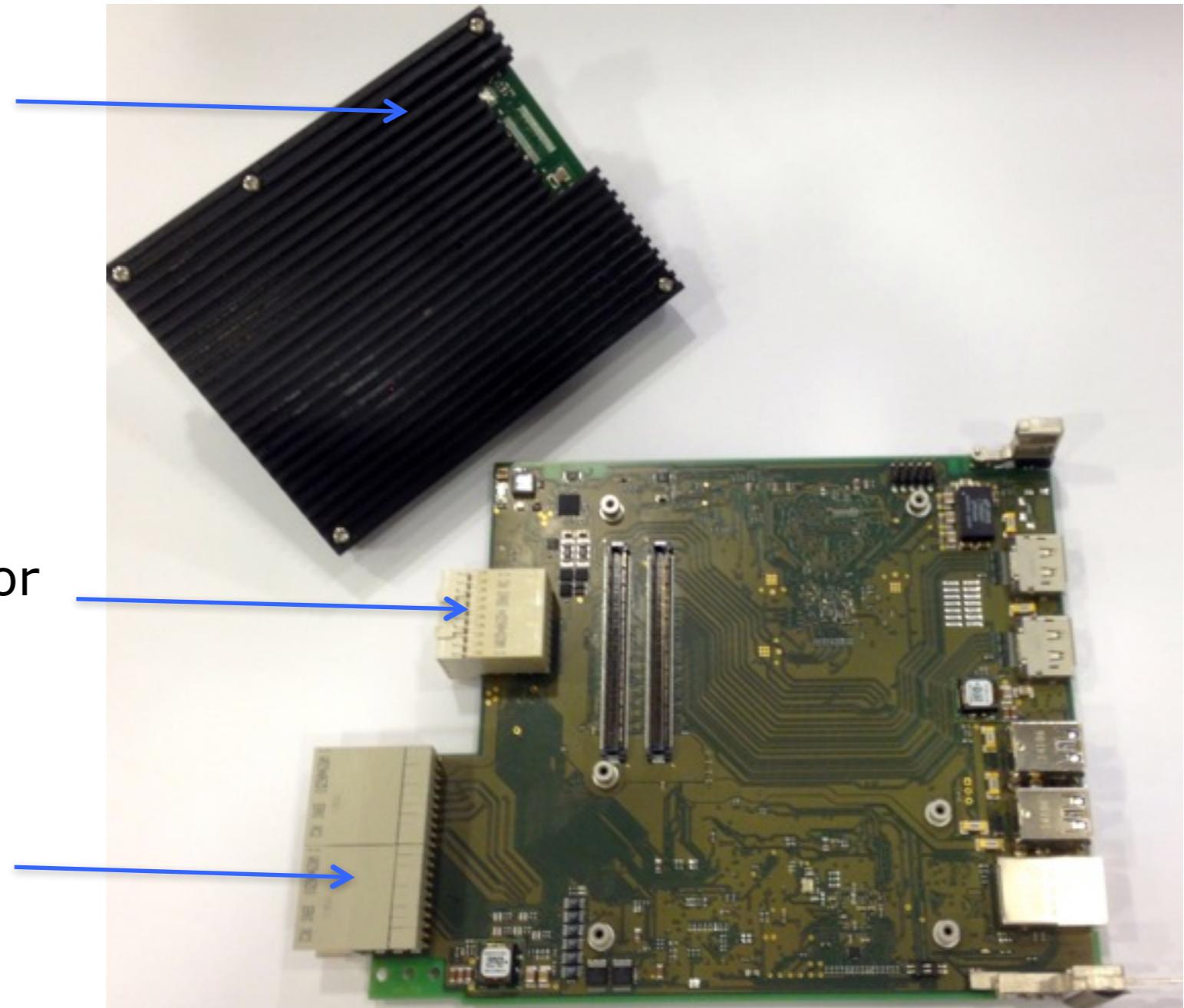
# Example MCH-RTM: NAT-MCH-RTM-BM: commercial available

Vollrath Dirksen  
Update on MTCA.4

*In2p3 June 2016*



Optional:  
COMexpress-CPU-Module

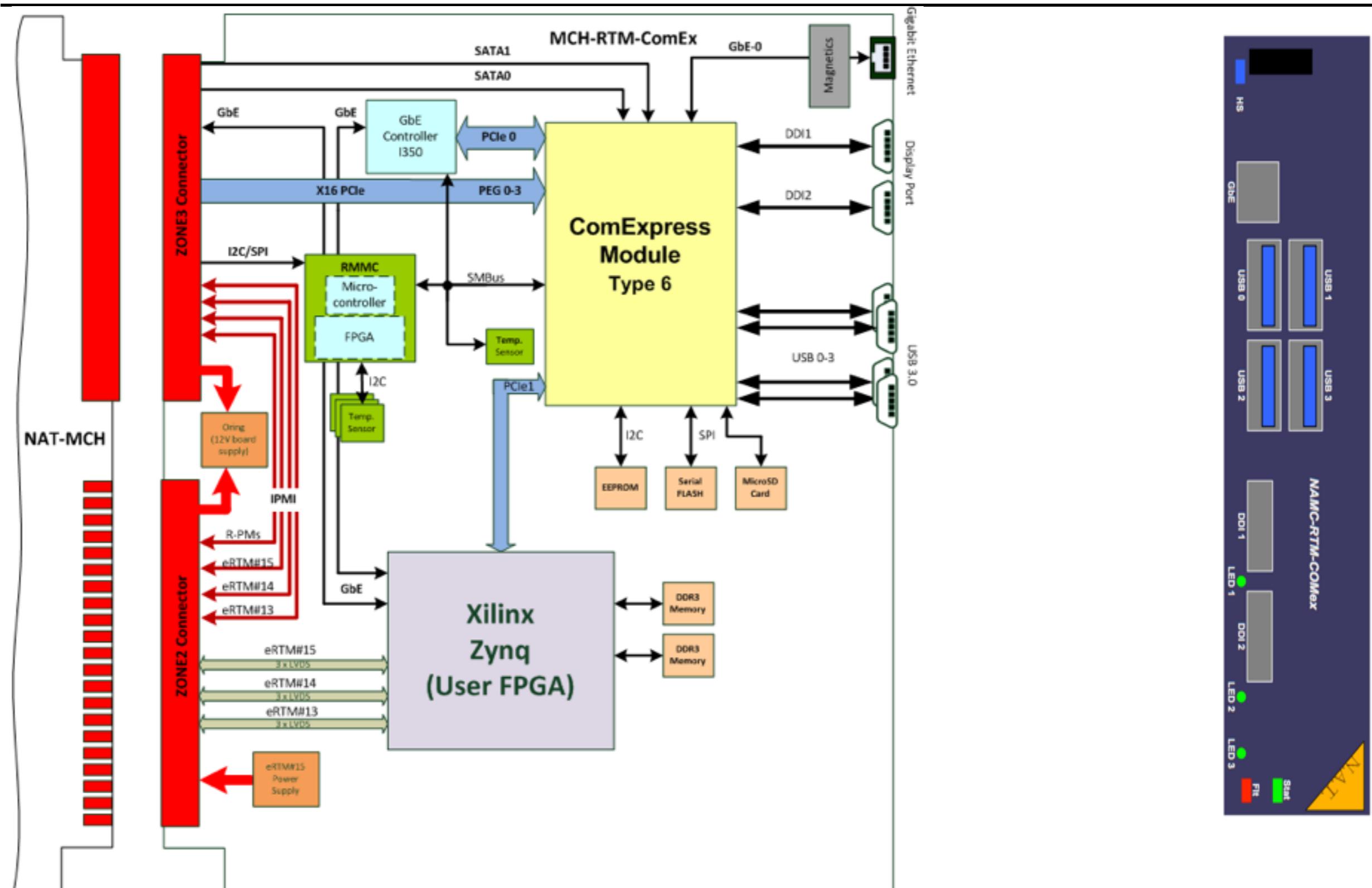
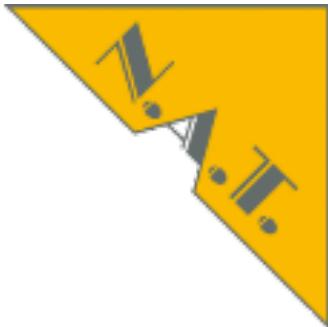


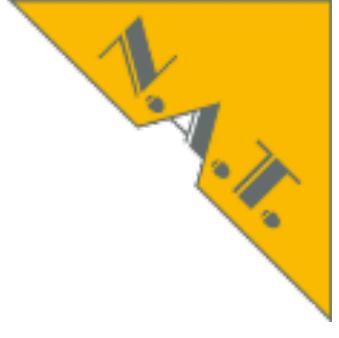
µRTM Power connector  
µRTM Control&Data connector

Second Zone3 connector

# NAT-MCH-RTM options

## -BM (Zone2), -FPGA (Zync), -COMEx-i7





# PICMG Standardisation

## Extension to MCH firmware

---

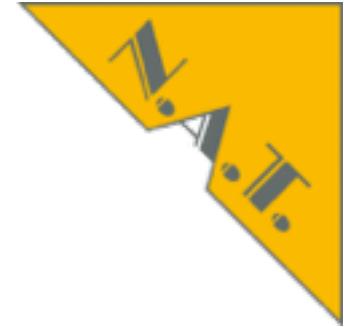
- New I2C addresses
- Extension of FRU-IDs for eRTMS
- New Power Records:
  - RF Carrier Activation Record (BP FRU)
  - Power Module Capability Record
  - Module Current Requirement Record
- E-Keying Support for RF high speed signals
- Sequencing of power up front and rear power modules ?

# MCH Firmware Extension

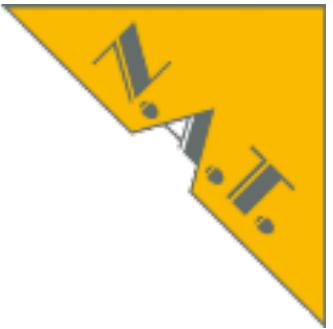
## Enhanced and new Commands

Vollrath Dirksen  
Update on MTCA.4

*In2p3 June 2016*



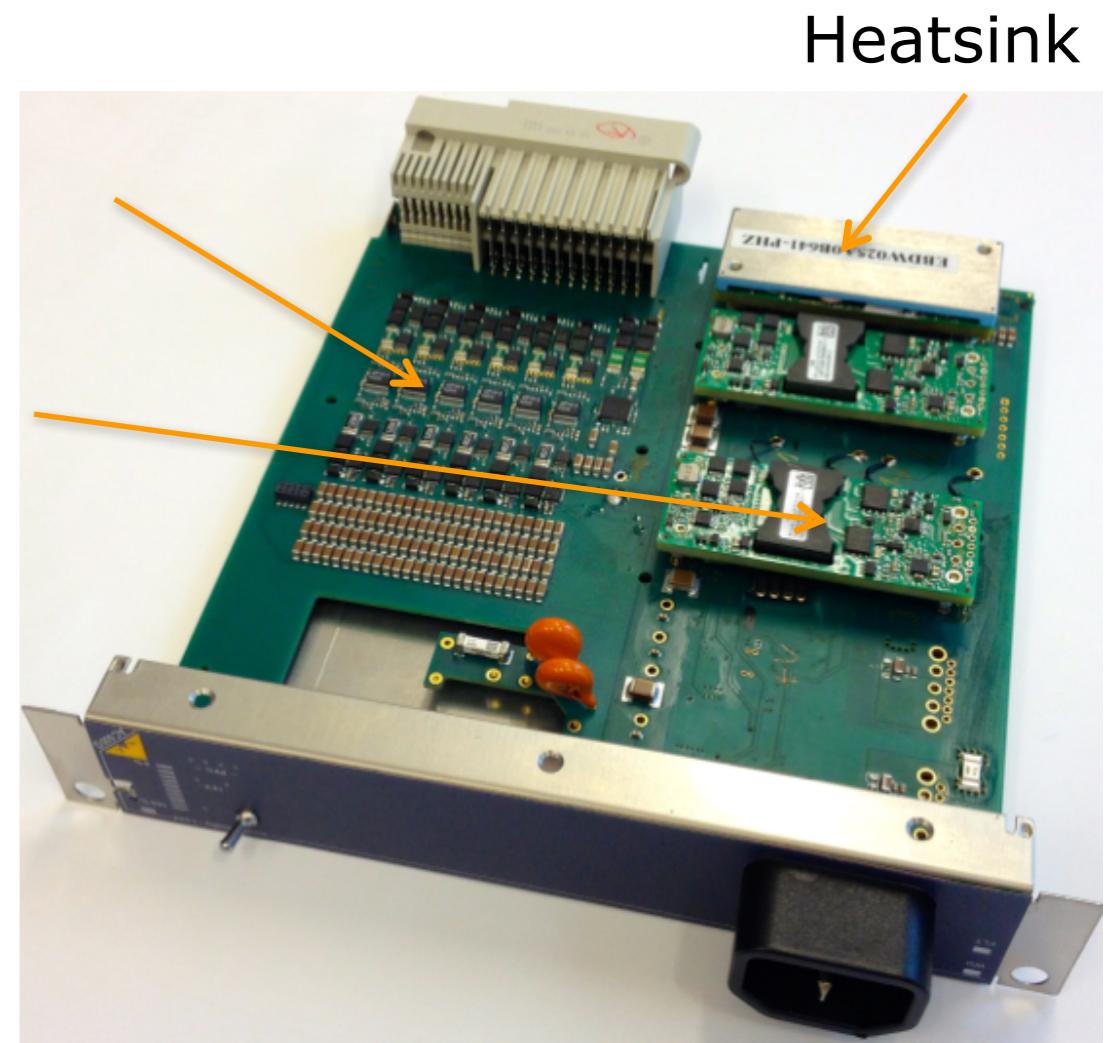
- `show_fruinfo <FRU-ID>`
  - shows power records of RPMs, μRTM
- `show_pm`
  - `show_pm rear`
    - shows rear power modules
  - `show_pm <FRU-ID>`
    - shows additional power records
  - `show_pm -r_vv_on <FRU-ID><pC><rail><Volt>`
    - enable variable voltage of RPM, power channel, rail-ID, voltage in 0.1V steps
  - `show_pm -r_vv_off <FRU-ID><pC><rail>`
    - disable variable voltage
- `start_erm15`
  - payload power (12V) for eRTM15
- `stop_erm15`



# Rear Power Module Example

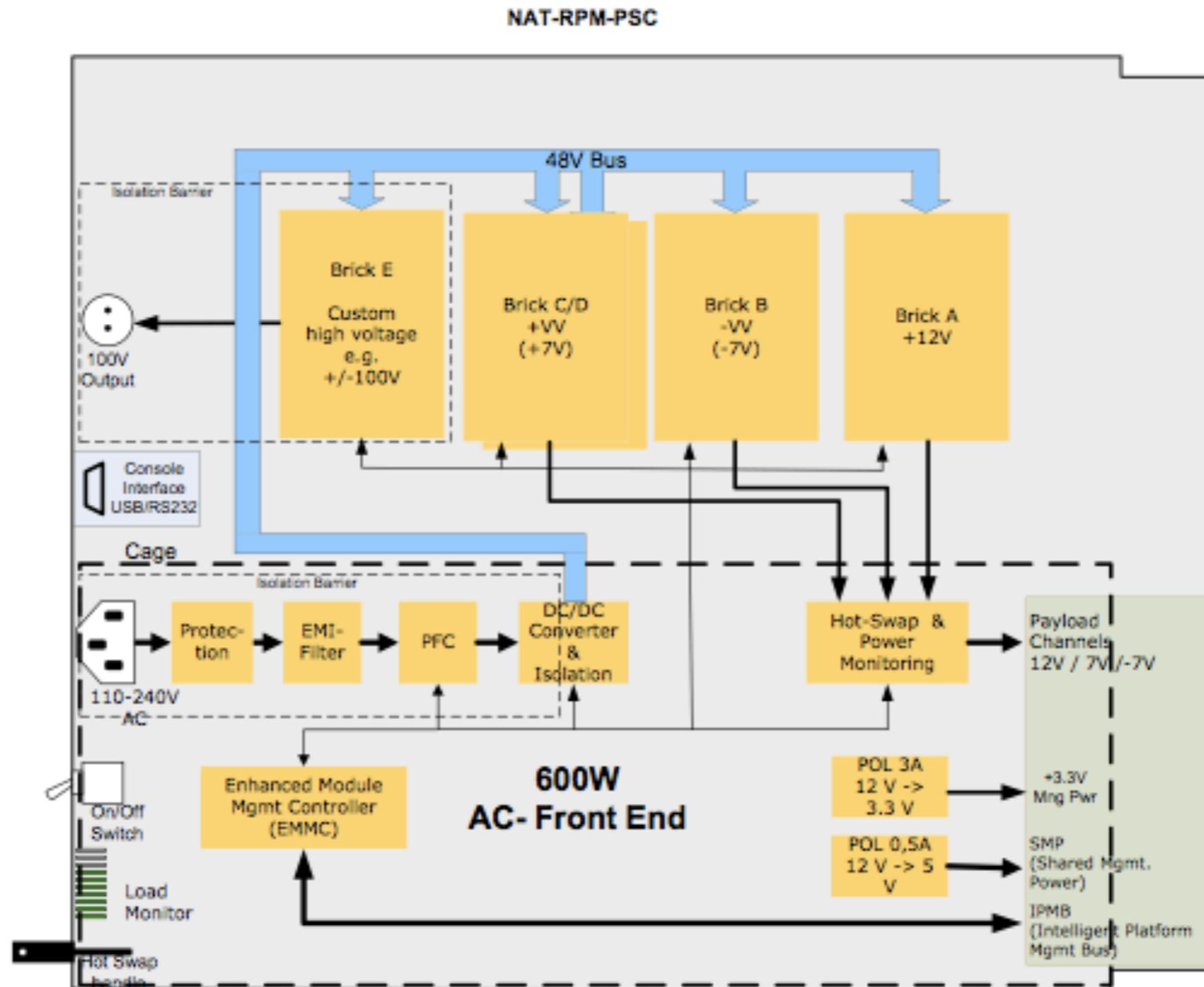
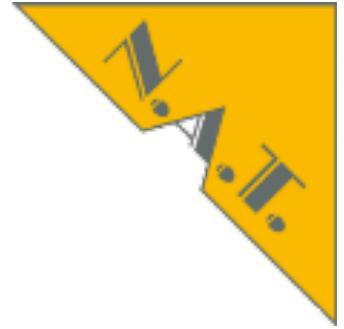
**NAT-RPM-PSC: soon commercial available**

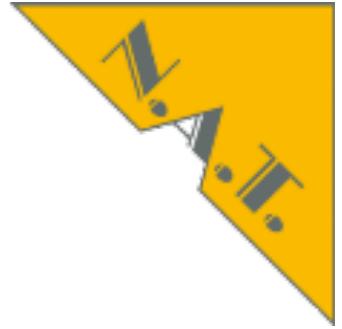
- Rear Power Module as Power Supply Carrier for
  - AC600 sub module with card cage
  - Up to 4 Sub modules for +V, -V
  - Submodules in different formats



# Rear Power Module

## NAT-RPM-PSC



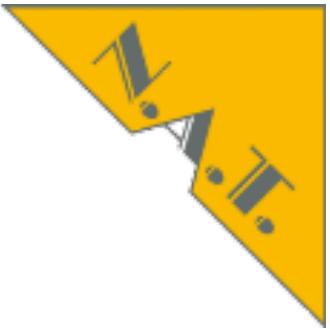


# Rear Power Module RPM

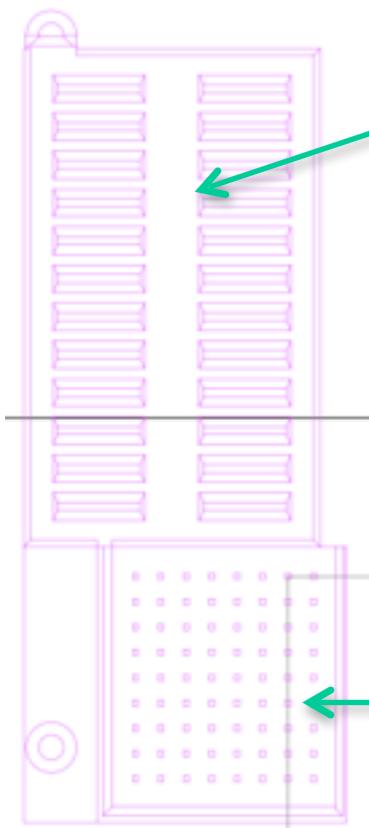
## Status

---

- Use of Standard Power Module Connector
- Pin assignment provides contention protection with standard Power Modules
- Provides power for:
  - MP for eRTMs – using pins of MCHs, CUs
  - PP for eRTMs – using pins of MCHs, CUs
  - **+VV for μRTMs – using AMC PP pins**
  - **-VV for μRTMs – using AMC #EN pins**



# Rear Power Module Standard and Specific

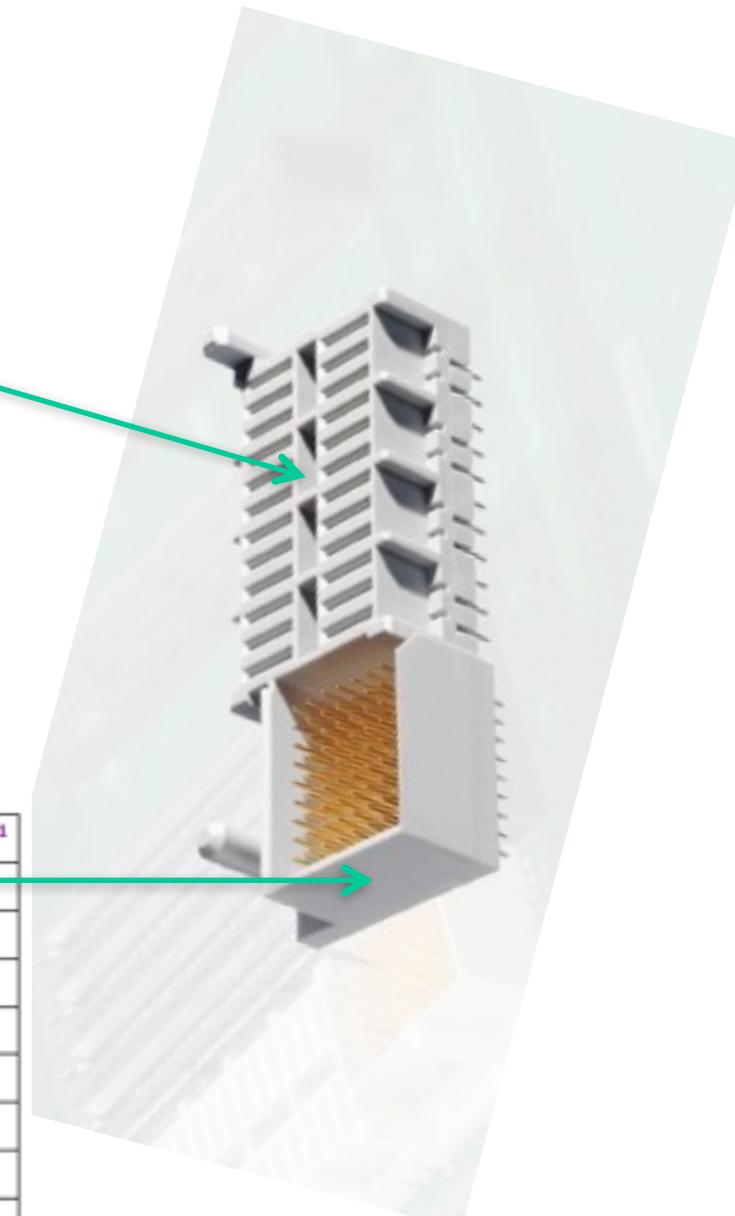


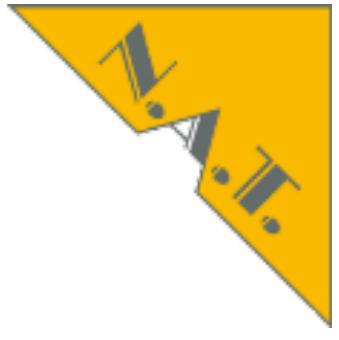
P13	+VV (#1)	PP+12V (#15)
P14	+VV (#2)	PP+12V (#13)
P15	+VV (#3)	PP+12V (#-1)
P16	+VV (#4)	GND
P17	+VV (#5)	GND
P18	+VV (#6)	GND
P19	+VV (#7)	GND
P20	+VV (#8)	GND
P21	+VV (#9)	GND
P22	+VV (#10)	GND
P23	+VV (#11)	GND
P24	+VV (#12)	PP+12V (#14)

P1  
P2  
P3  
P4  
P5  
P6  
P7  
P8  
P9  
P10  
P11  
P12

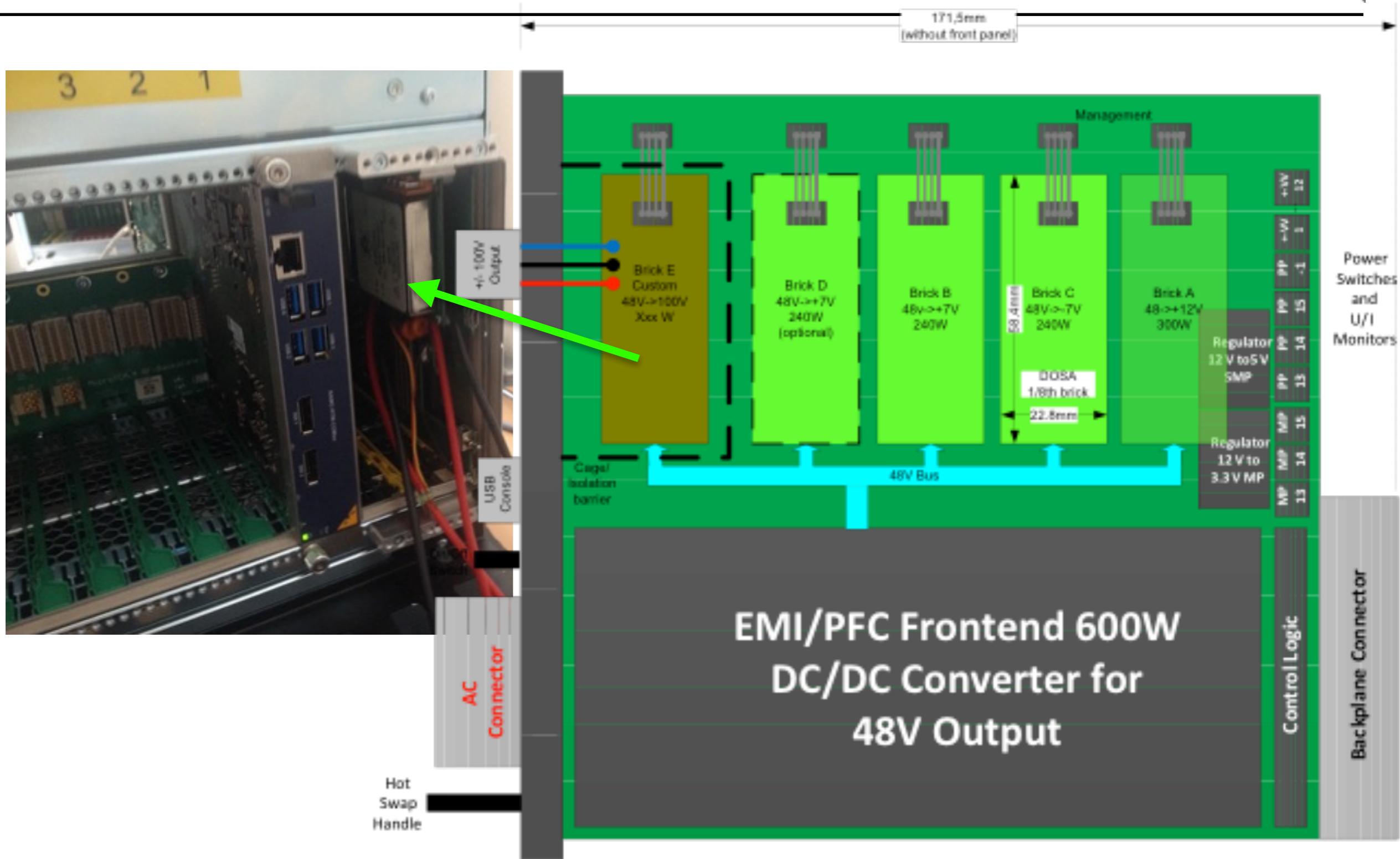
	H	G	F	E	D	C	B	A
1	MP+3.3V (#13)	MP+3.3V (#15)	ENABLE# (#13)	ENABLE# (#15)	PS1# (#13)	PS1# (#15)	PM_OK#	PS_PM# <sup>1</sup>
2	n.c.	n.c.	-VV (#1)	-VV (#2)	PS1# (#1)	PS1# (#2)	PMP_A#	n.c.
3	n.c.	n.c.	-VV (#3)	-VV (#4)	PS1# (#3)	PS1# (#4)	n.c.	n.c.
4	n.c.	n.c.	-VV (#5)	-VV (#6)	PS1# (#5)	PS1# (#6)	PMP_C#	n.c.
5	n.c.	n.c.	-VV (#7)	-VV (#8)	PS1# (#7)	PS1# (#8)	RST_PM_IN#	n.c.
6	n.c.	n.c.	-VV (#9)	-VV (#10)	PS1# (#9)	PS1# (#10)	RST_PM_A#	n.c.
7	n.c.	n.c.	-VV (#11)	-VV (#12)	PS1# (#11)	PS1# (#12)	n.c.	GA0 <sup>2</sup>
8	n.c.	MP+3.3V (#14)	ENABLE# (#-1)	ENABLE# (#14)	PS1# (#-1)	PS1# (#14)	RST_PM_C#	GA1 <sup>2</sup>
9	PWR_ON (#15)	PWR_ON (#14)	SDA_A	SCL_A	SDA_B	SCL_B	SMP	GA2 <sup>2</sup>

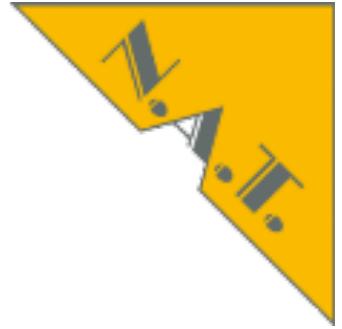
n.c. – not connected





# 100V Piezo-Switch



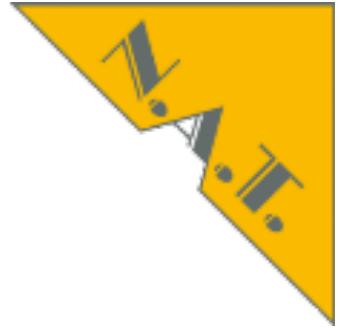


# MCH Firmware Extension

## Enhanced and new Commands

---

- `show_fruinfo <FRU-ID>`
  - shows power records of RPMs, µRTM
- `show_pm`
  - `show_pm rear`
    - shows rear power modules
  - `show_pm <FRU-ID>`
    - shows additional power records
  - `-r_vv_on <FRU-ID><pC><rail><Volt>`
    - enable variable voltage of RPM, power channel, rail-ID, voltage in 0.1V steps
  - `-r_vv_off <FRU-ID><pC><rail>`
    - disable variable voltage
- `start_erm15`
  - payload power (12V) for eRTM15
- `stop_erm15`



# MTCA.4 Update

## Agenda

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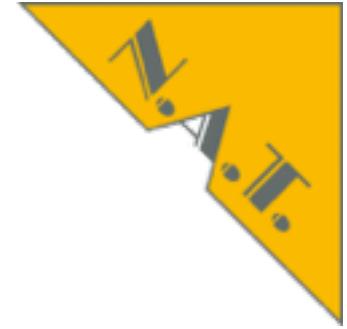
- Introduction N.A.T.
- History of MicroTCA and Comparison of Standards
- Markets of MicroTCA
- MTCA.0
- MTCA.4
- Upcoming MTCA.4.1 Standard
- New Trends in MTCA.4

# Market MTCA.4

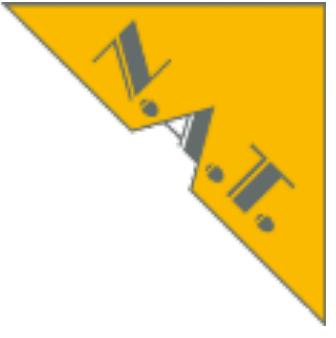
## Trend

Vollrath Dirksen  
Update on MTCA.4

*In2p3 June 2016*



- Lab usage
  - 7 slot 5U MTCA.4
- Usage of big 19" systems
  - 12 slot MTCA.4 system with 12 µRTMs
  - 12 slot MTCA.4 systems, only **6** µRTMs but double (AMC and µRTM **full-size**)
  - MTCA.4 system without RTM
    - NATIVE-C5 instead of NATIVE-R5 (trigger bus important)
    - Respin of 11850-015 (JTAG Switch slot interesting)
- Usage of smaller 19" systems
  - 6 slot 2U MTCA.4
  - Demand of 8 or 16 PCIe lanes (NATIVE-R2, NATIVE-R3, MCH-RTM)
- Latest requests with need of small number of slots (2 to 4)
  - JTAG Switch Module (NAT-JSM)
  - see NATIVE-mini and NATIVE-R2



# New NATIVE-R9

## Better Cooling for μRTMs



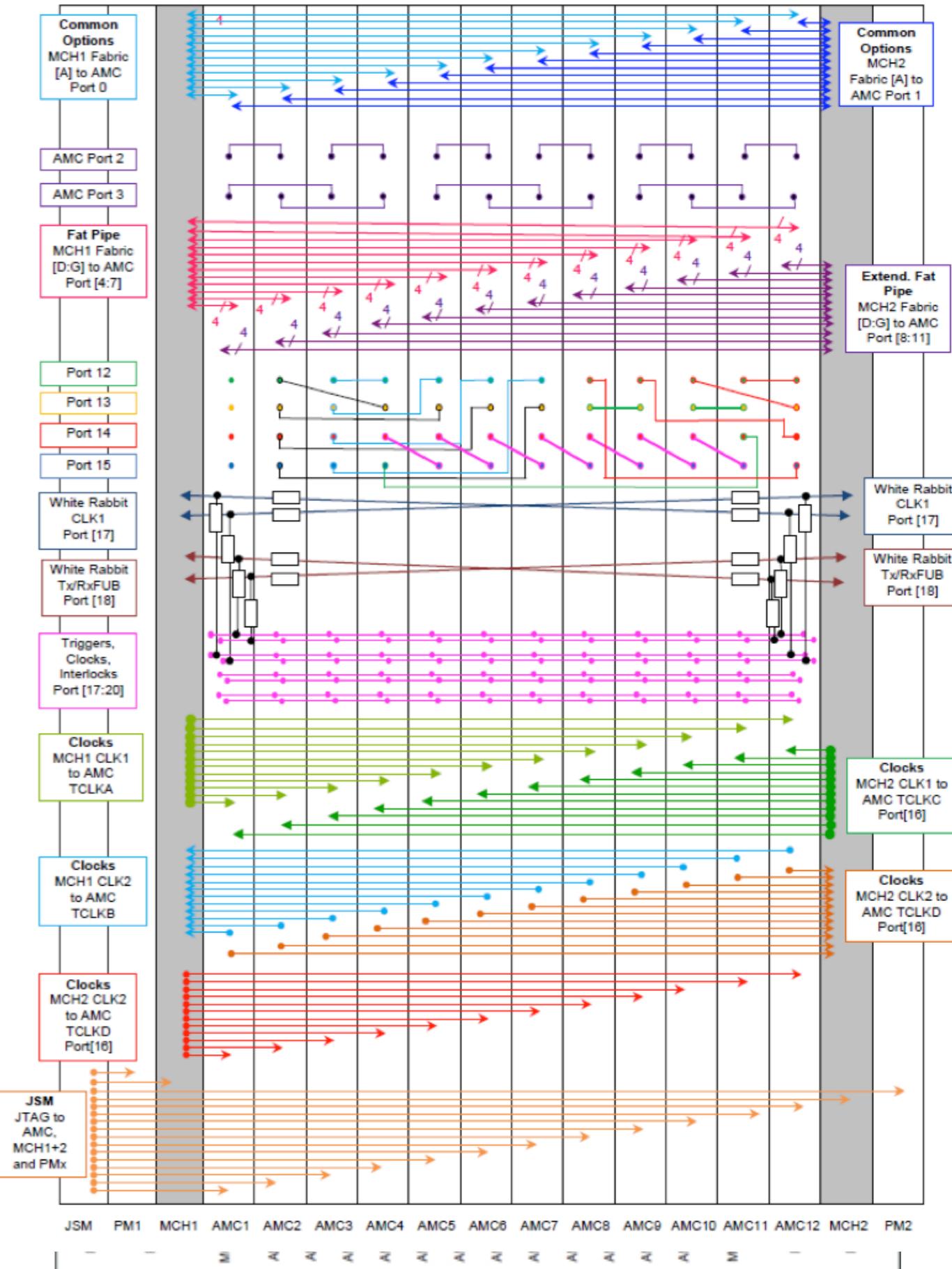
# NEW NATIVE-R9

## JSM slot and White-Rabbit

- White Rabbit Support
  - optional
  - set of registers
  - connect reserved clock pins to
    - bus for Triggers, Clocks, Interlocks

old NATIVE-R9

- JSM (JTAG Switch Module) Slot connected
  - to all AMCs, MCHs and PMs



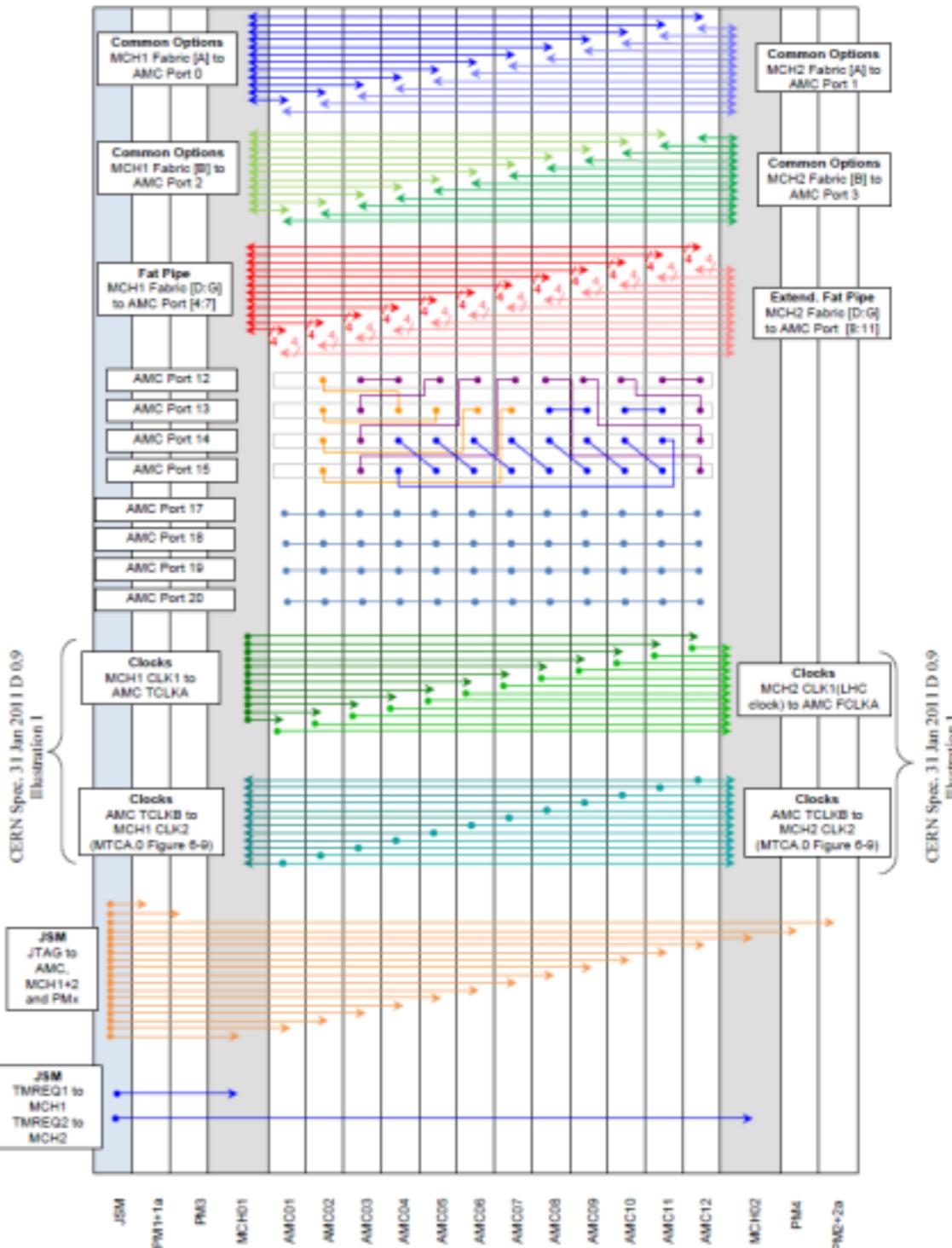
# Market MTCA.4

## Alternative to Vadatech Chassis

Vollrath Dirksen  
Update on MTCA.4

*In2p3 June 2016*

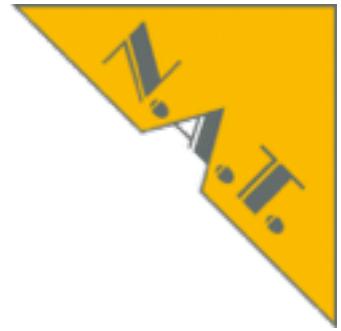
- Demand
  - double, full-size
  - JTAG
  - DC power supply
  - less RTMS
- Front Module Slots:
  - 12 x AMC slots double, full-size
  - 2 x single PM (Power Module) slots
  - 2 x MCH slots
- Rear Module Slots:
  - 6 x RTM slots double, full-size
  - 4 x single PM (Power Module) slots
  - 1 x JSM (JTAG Switching Module)
- 19" wide x Height 7U
- Push-Pull cooling with front removable fan trays
- Air flow bottom to top
- N.A.T.
  - NAT-PM-DC840
  - NAT-MCH-Base12-GbE
  - NAT-MCH-PHYS80 with PCIe optical uplink but without Zone3



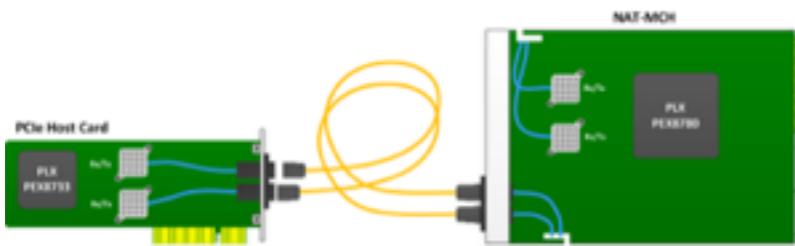
# PCI Express Uplink/Cascading: Examples

Vollrath Dirksen  
Update on MTCA.4

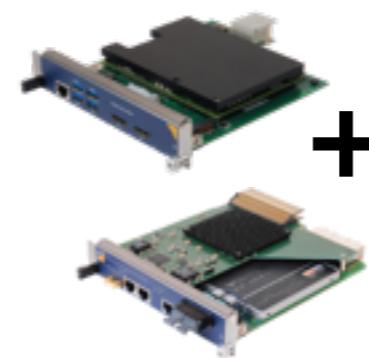
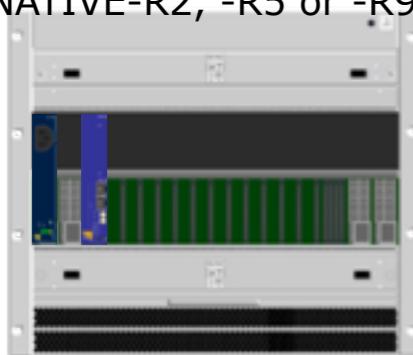
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## purely optical



NATIVE-R2, -R5 or -R9



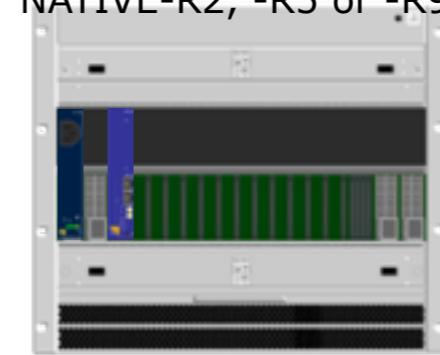
**x16** OR **x8**



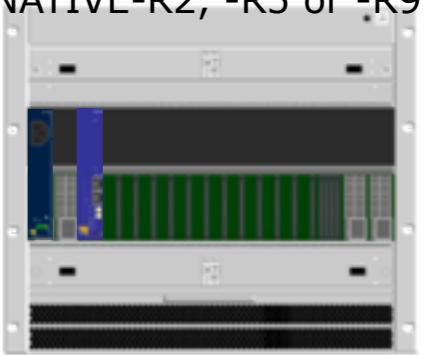
## optical + copper



NATIVE-R2, -R5 or -R9



NATIVE-R2, -R5 or -R9



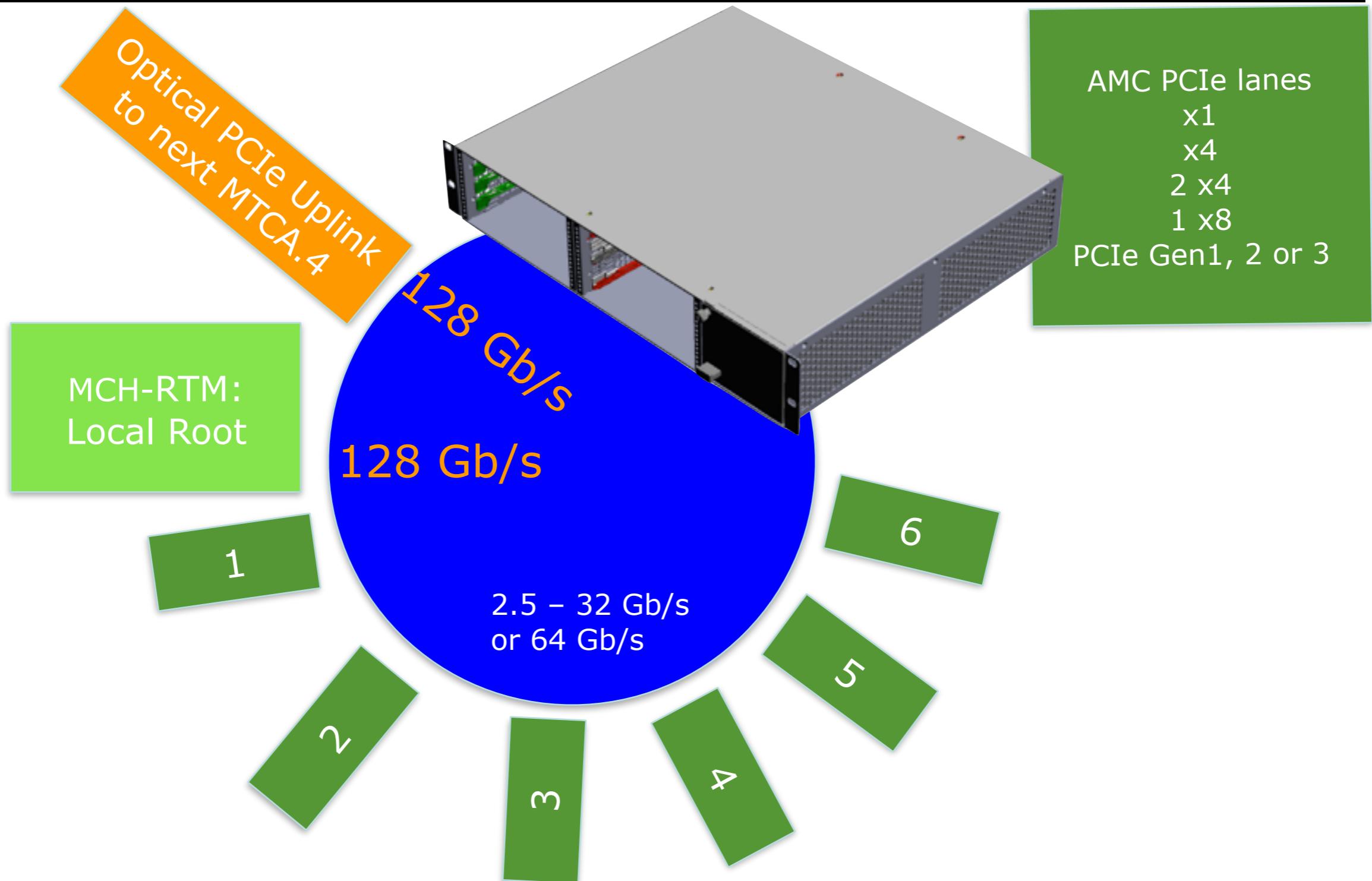
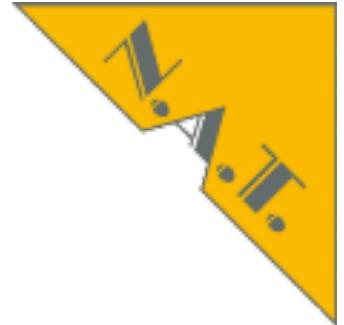
**x16 CU**

**x8 optical**



# NATIVE-R2

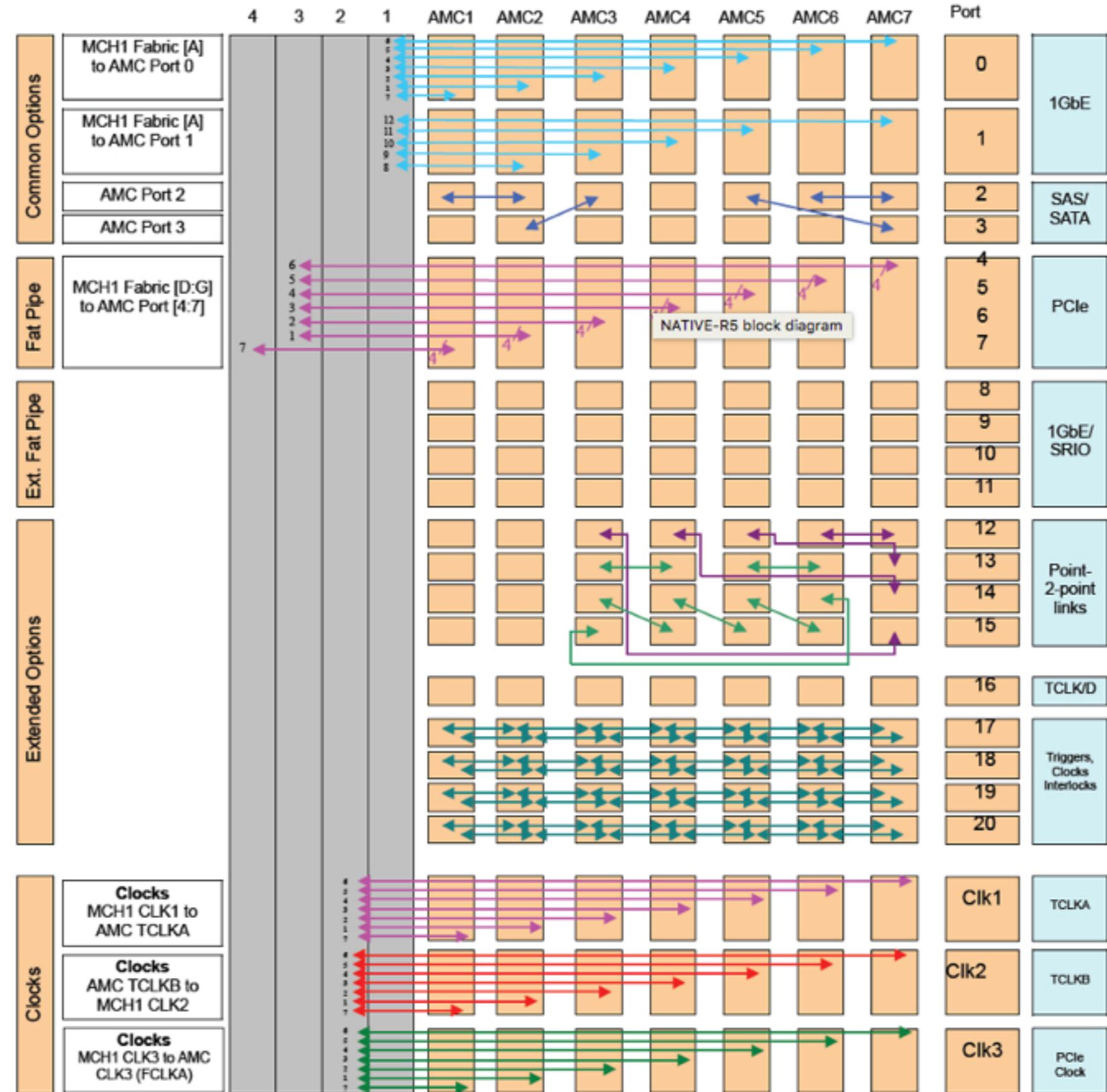
## Clustering, Uplink, Cascading of systems

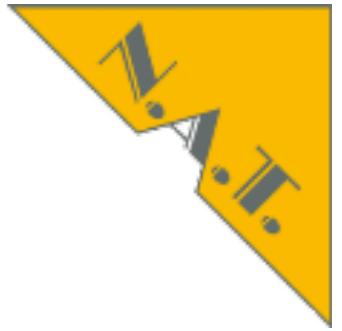


# NATIVE-R5

## 5U MTCA.4 Chassis

- Chassis dimensions:
  - Width: 217.72 mm (ca. 4.25 inches)
  - Height: 221.45 mm (5U)
  - Depth: 373.30 mm
  - two fit in 19inch chassis side-by-side
- air flow: bottom to top
- 6 double, mid-size AMC + I/O
- 1 double, full-size AMC + μ
- 1 double, full-size MCH + F
- 1 double, full-size PM slot
- single size AMCs can be inserted:
  - using splitting kits
  - NAMC-Filler-MS-FP0S
- MCH connections
  - Port 0 of AMC1-7
  - Port 1 of AMC2,3,4,5,7
  - Port 4-7 of AMC1-7
  - Port 12-15 direct connect to MCH
  - Port 17-20 bus according to table

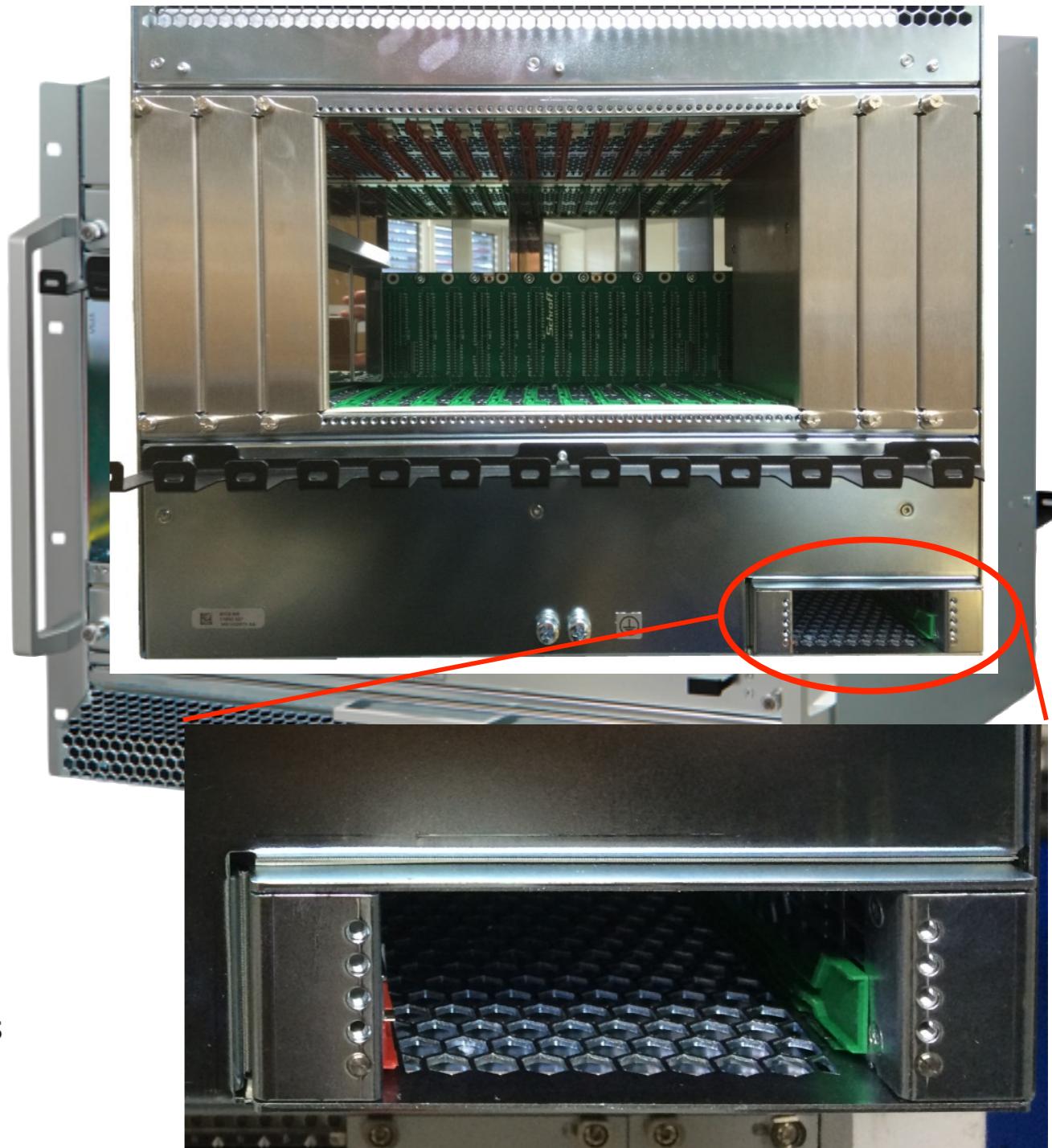




# NEW NATIVE-R9

## JSM slot and White-Rabbit-Support

- Chassis dimensions:
  - Width: 217.72 mm (ca. 42HP = 19 inch)
  - Height: 397,25 mm (9U)
  - Depth: 373.30 mm / 473,30 mm with cable trays
- air flow: front to rear
- 12 double, mid-size AMC +  $\mu$ RTM slots
  - or 6 double, full-size AMC +  $\mu$ RTM slots
- 2 double, full-size MCH + **RTM** slots (MTCA.4.1)
- 4 double, full-size PM slots
- single size AMCs can be installed
  - using splitting kits
  - NAMC-Filler-MS-FP0S
- MCH 1 and MCH2 connections
  - Port 0 of AMC1-12 to MCH1
  - Port 1 of AMC1-12 to MCH2
  - Port 4-7 of AMC1-12 to MCH1
  - Port 8-11 of AMC1-12 to MCH2
- Port 12-15 point-to-point connections (MTCA.4)
- Port 17-20 bus for trigger, clock and interlock signals

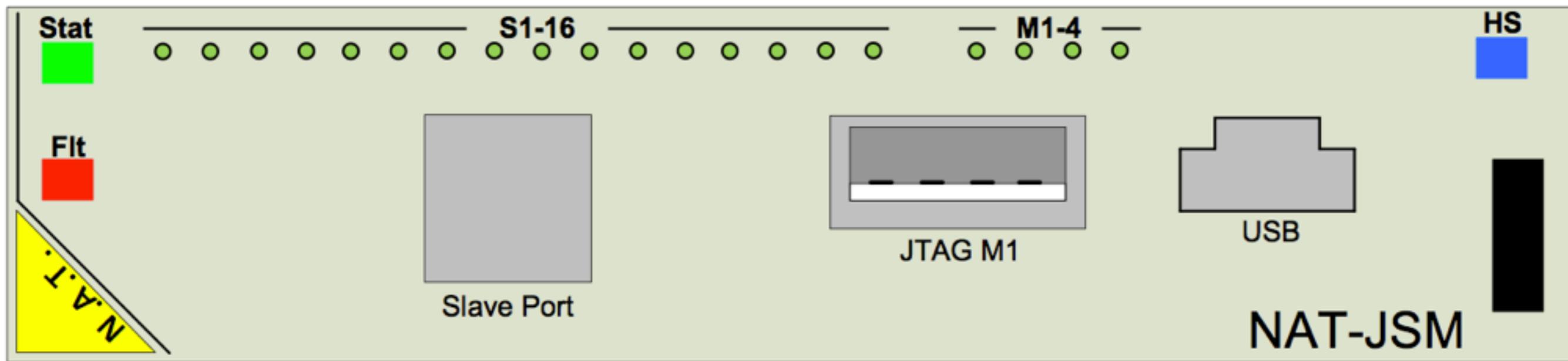
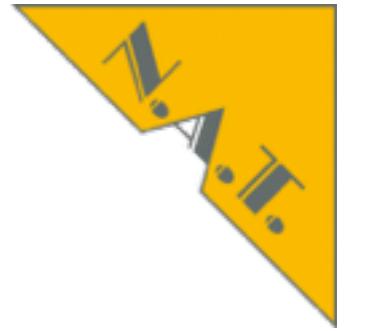


# NAT-JSM

## Front Panel

Vollrath Dirksen  
Update on MTCA.4

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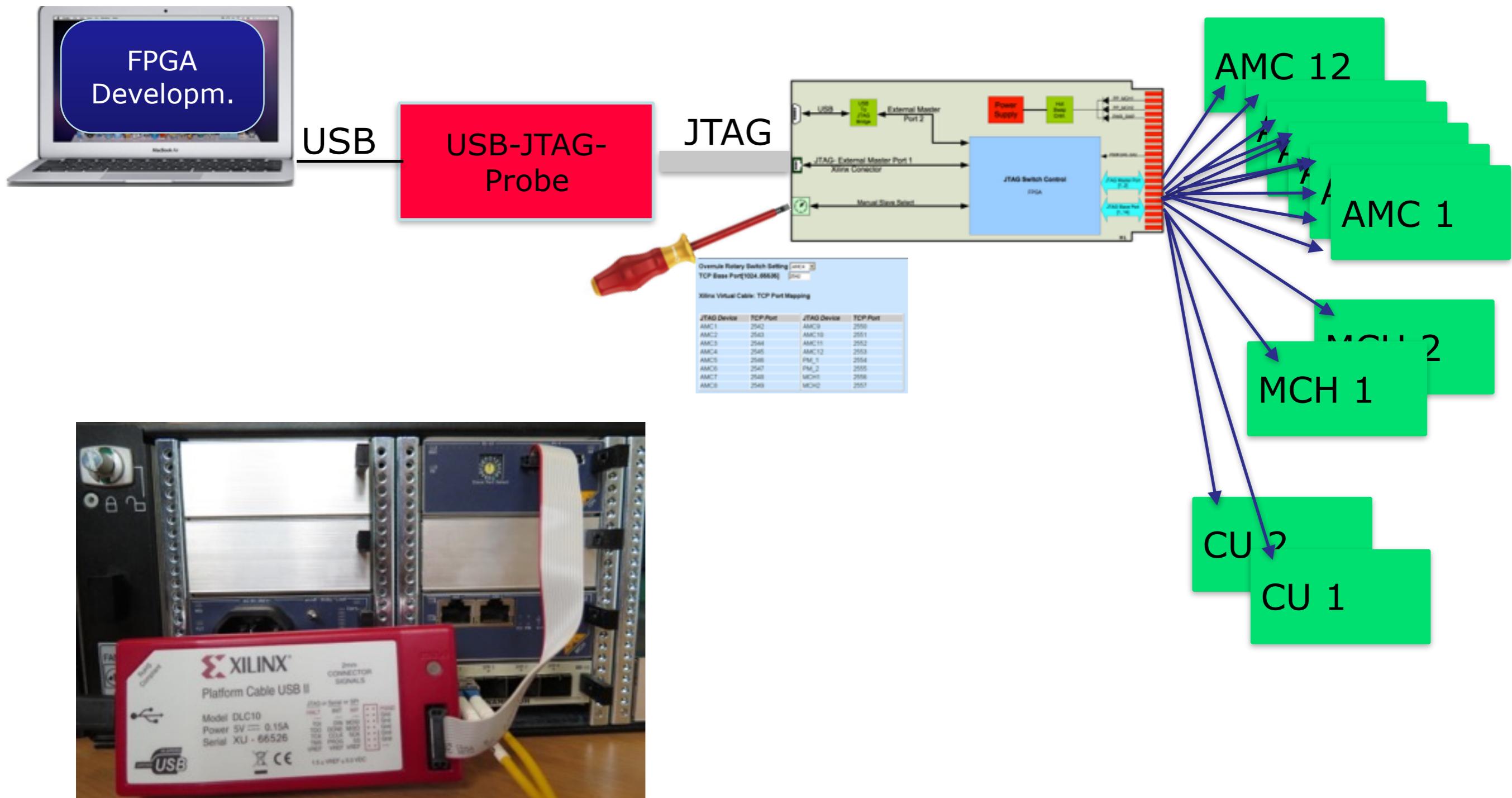
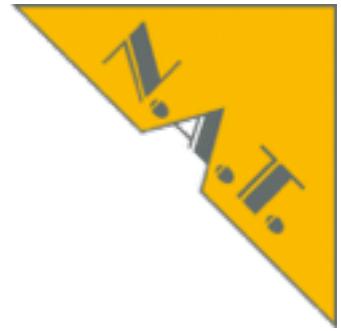


# NAT-JSM JTAG Connection

## JTAG-Probe of Xilinx, Lattice, Altera etc

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Update on MTCA.4

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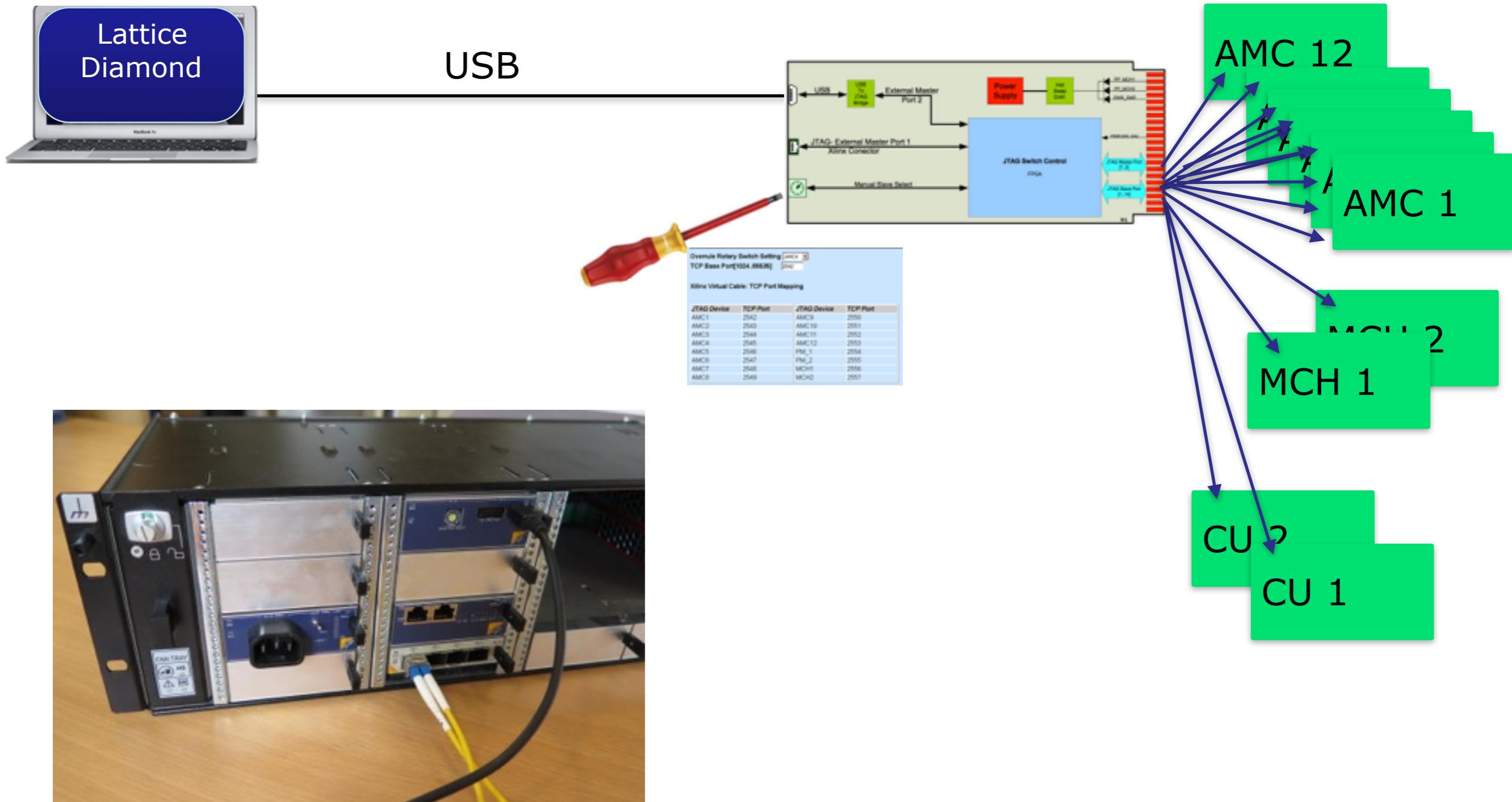
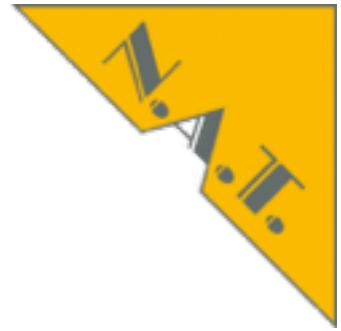


# NAT-JSM JTAG Connection via USB

## Lattice – Diamond Programmer 3.0

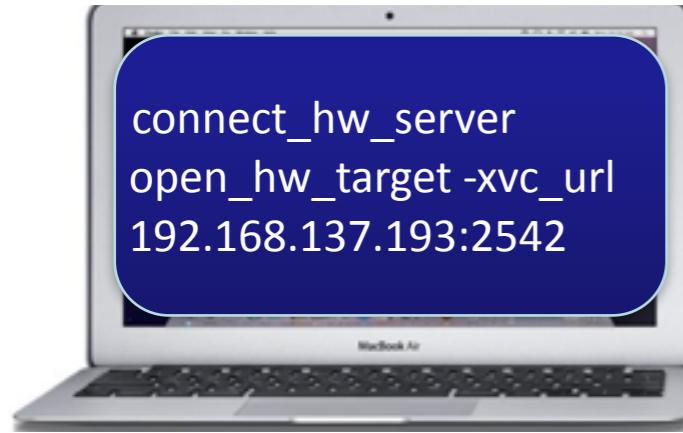
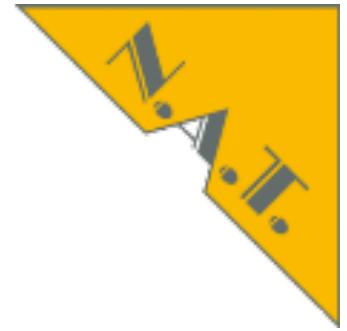
Vollrath Dirksen  
Update on MTCA.4

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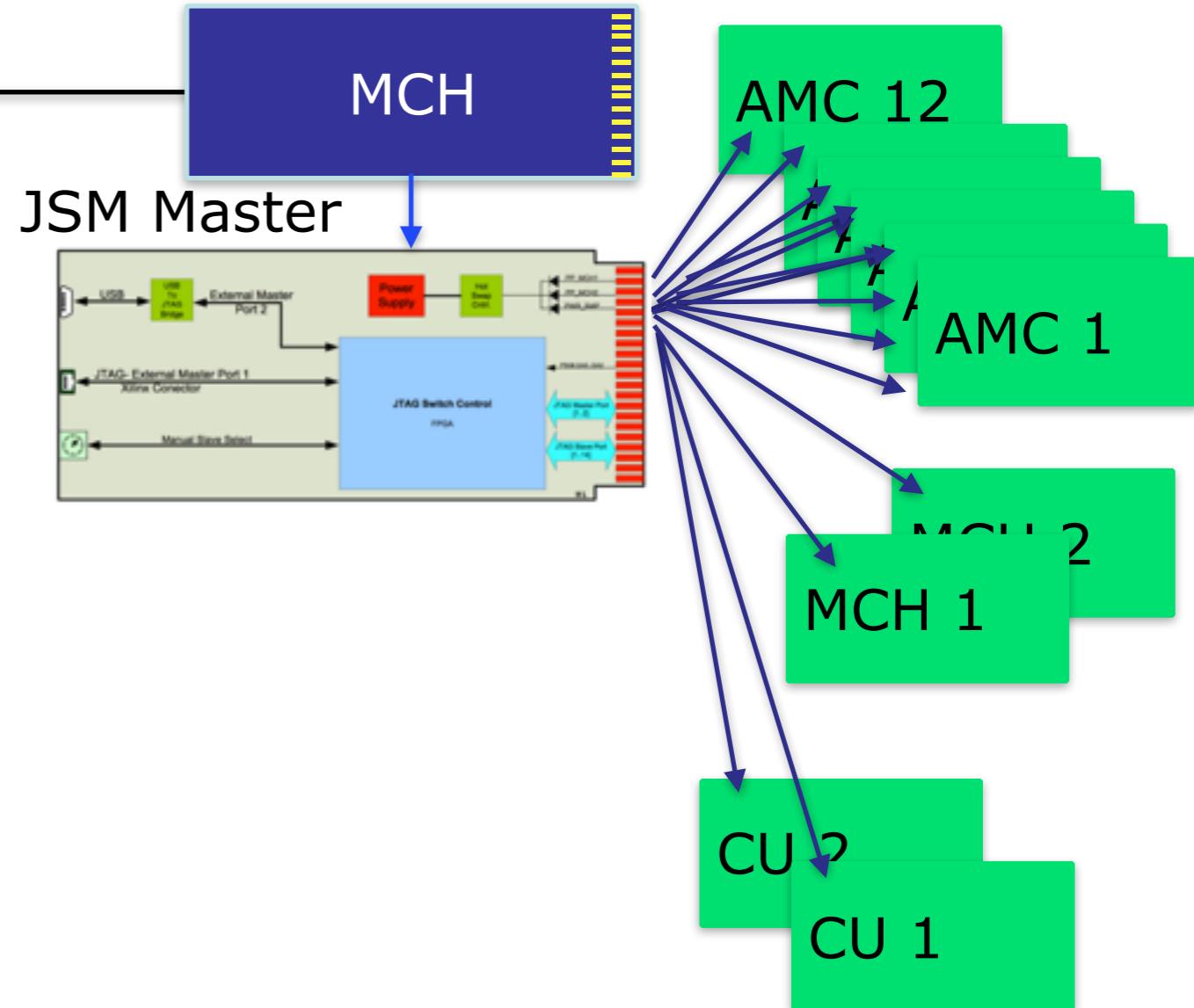


# JTAG Switch Module by N.A.T.

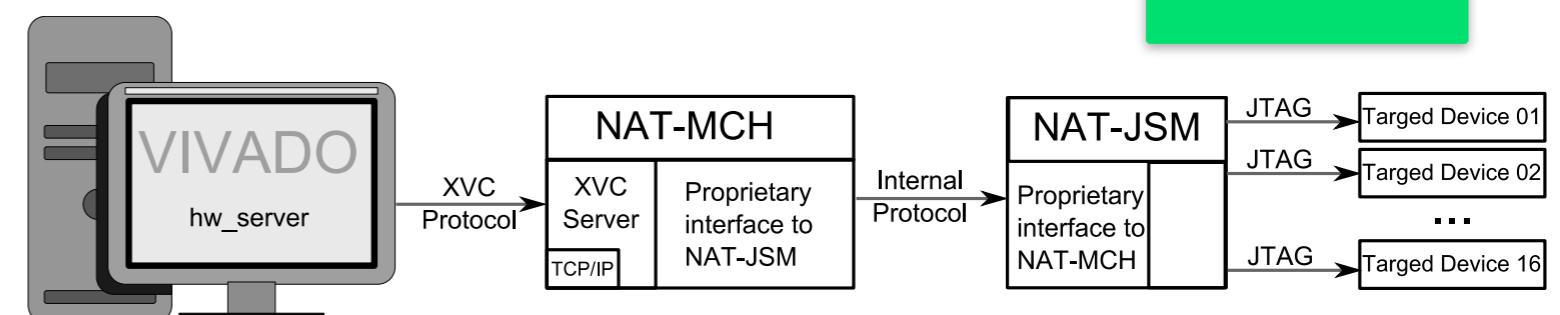
## NAT-JSM: compact, versatile, flexible



Ethernet



JTAG connection by virtual probe, i.e. Xilinx Vivado



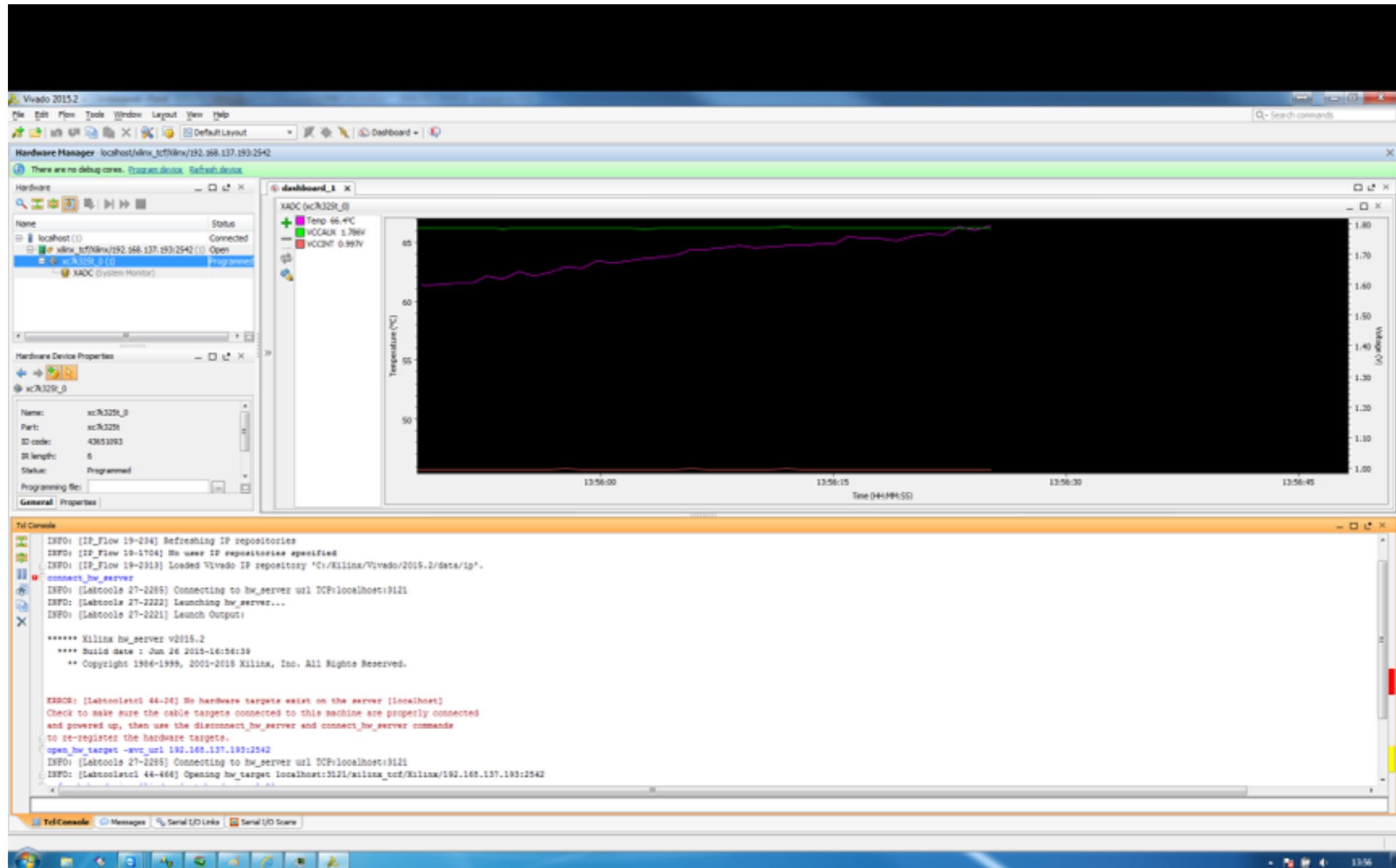
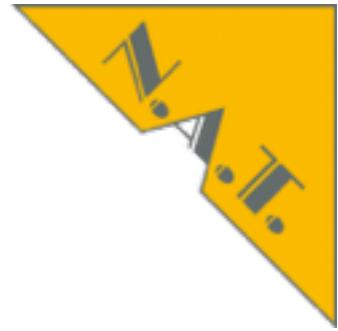
# Xilinx Vivado Software

## Console Commands and

## Hardware-Monitor (live Temp and Voltages)

Vollrath Dirksen  
Update on MTCA.4

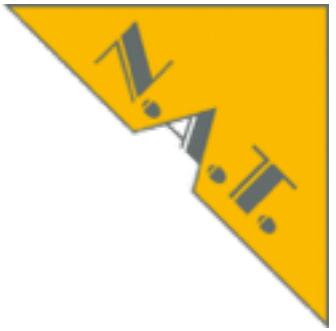
**In2p3 June 2016**



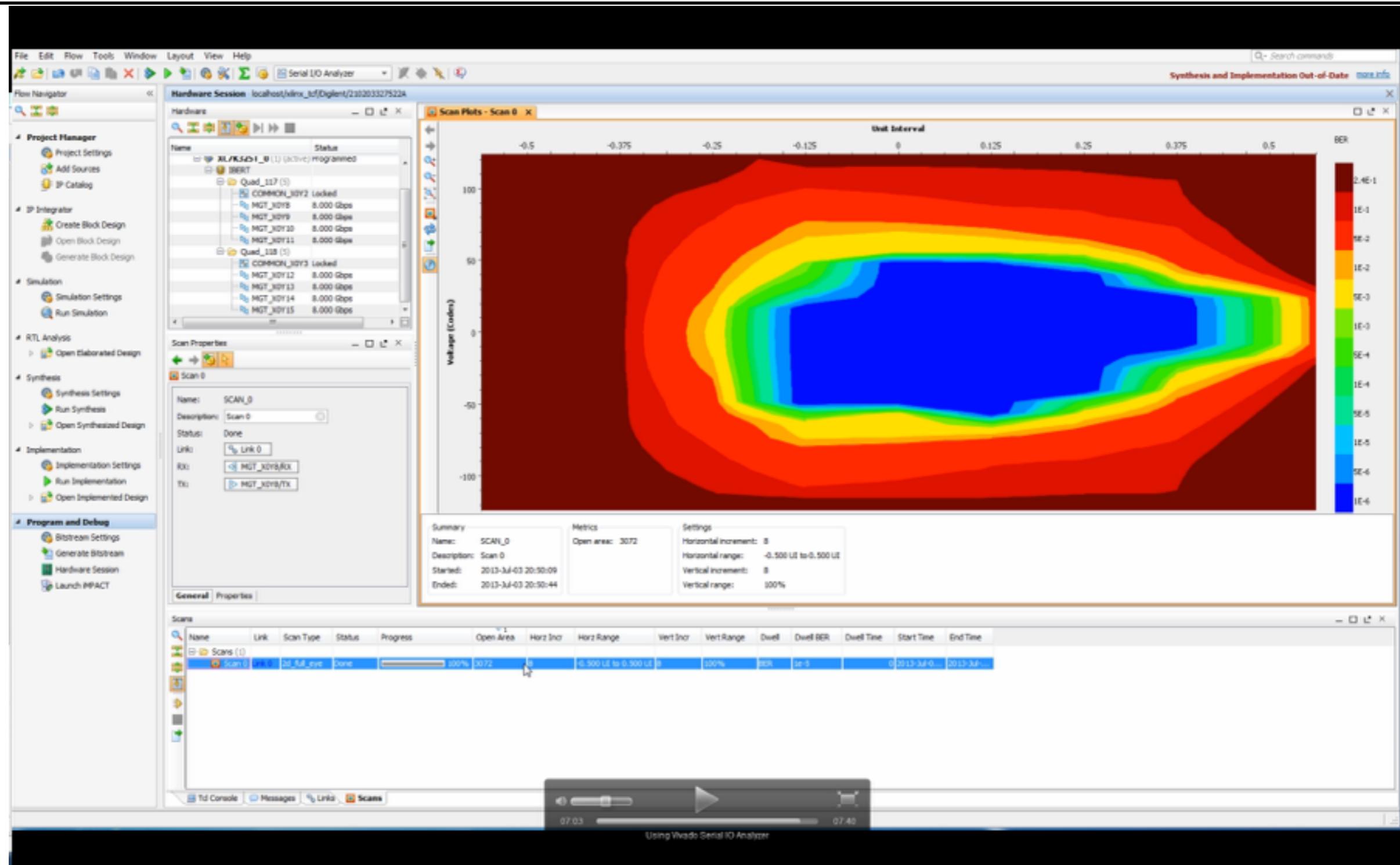
# Xilinx Vivado Software

## Tutorial IBERT Tool (live via JTAG Tuning and Analysis of SerDes, Eye-Opening)

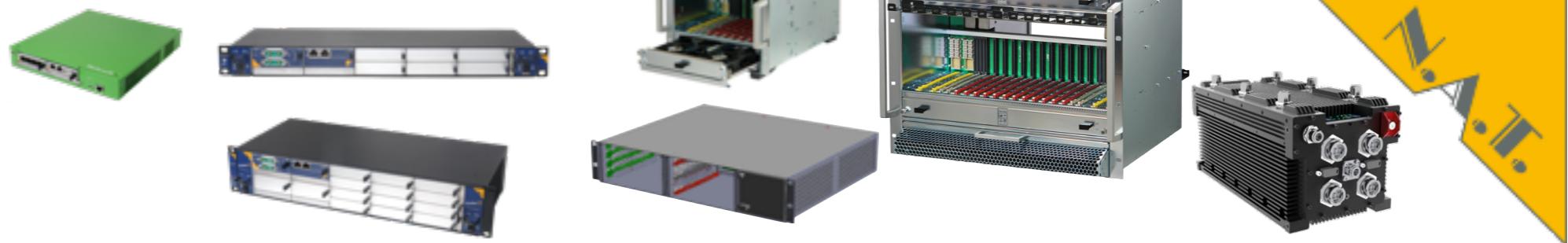
Vollrath Dirksen  
Update on MTCA.4



**In2p3 June 2016**



# NATIVE Summary



<b>Standard</b>	<b>Name</b>	<b>Size</b>	<b>AMC Slots</b>	<b>µRTM Slots</b>	<b>MCH Slots</b>	<b>Cooling Unit Slots</b>	<b>Power module Slots</b>	<b>JSM</b>	<b>Comment</b>	<b>Dust filter</b>
	NATIVE-mini	1U	2 sm or 2 sf or 1 df	-	-	-	-	-	eMCH, Cooling unit, power module	1
<b>MTCA.0</b>	NATIVE-C1	19", 1U	6 sm or 3 sf or 2sm+4dm	-	1 sf	2	1 sf	soon	-	1
	NATIVE-C2	19", 2U	12 sm or 6 sf or 4sm+4dm or ...	-	2 sf	2	2 sf	soon	-	1
	NATIVE-C5	5U	6 dm +1 df or 7 dm or single/double mix	-	1 df	1	1 df	no	-	1
<b>MTCA.1</b>	NATIVE-SX	3U	3 sm + 2 sf	-	1 sf	-	-	-	Cooling Unit, Power Module	no
	NATIVE-IPC	19", 4U	12 sm (pluggable from Rear)	-	2 sf	1	2 sdf	-	direct replacement for IPC	1
<b>MTCA.4</b>	NATIVE-R2	2U	5 dm + 1 df	4 dm + 1 dm(if no JSM)	1 df + RTM	1	1 df	yes	-	1
	NATIVE-R5	5U	6 dm +1 df or 7 dm or single/double mix	6 dm + 1 df or 7 dm	1 df + RTM	1	1 df	no	-	1
	NATIVE-R9	19", 9U	12 dm or 6 df or single/double mix	12 dm or 6 df or combination	2 df + 2RTM	2	4 df or 2 ddf	yes	-	1
<b>MTCA.2</b> <b>MTCA.3</b>	on request									

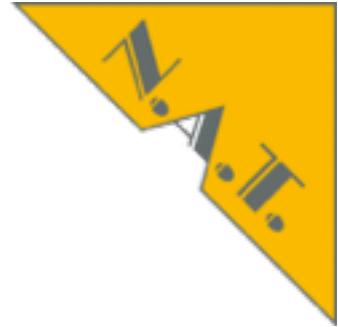


sm single width, mid-size  
 sf single width, full-size  
 dm double width, mid-size  
 df double width, full-size  
 ddf double width, double-full-size

# Questions

Vollrath Dirksen  
Update on MTCA.4

*In2p3 June 2016*



Danke  
Thanks  
Arigatô  
Toda  
Tack  
Merçi  
Xièxie  
Graças  
Dhanyavad  
Gamsahamnida