NAT-MCH Gen4

MTCA workshop for accelerator and physics in Japan 2025
KEK, Tsukuba
August 28th, 2025

UNCLASSIFIED

1

The new NAT-MCH Gen4 in 15 minutes

- Status of current NAT-MCH generation 3
- NAT-MCH-G4: the new NAT-MCH generation 4
- Migration from NAT-MCH Gen3 to NAT-MCH Gen4

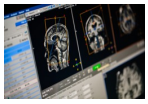
2

NAT-MCH Gen3

- Today the NAT-MCH Gen3 is being used in almost any vertical market:


Quantum Computer


Vision and AI


Medical


(Tele-) Communication


Military


Traffic


Research


Industrial Control


Test & Measurement

… and many more

- The NAT-MCH Gen3 is shipped since early 2007 with more than 18.500 deployed units
- Component obsolescence and limitations for extensions require new design

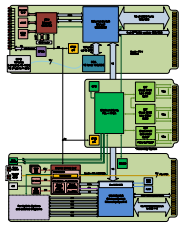
3

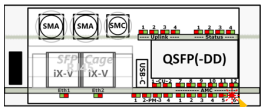
NAT-MCH

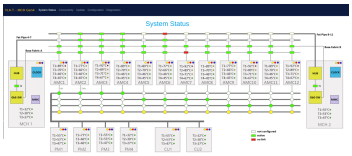
Generation 4

4

NAT-MCH Gen4 – in a nutshell







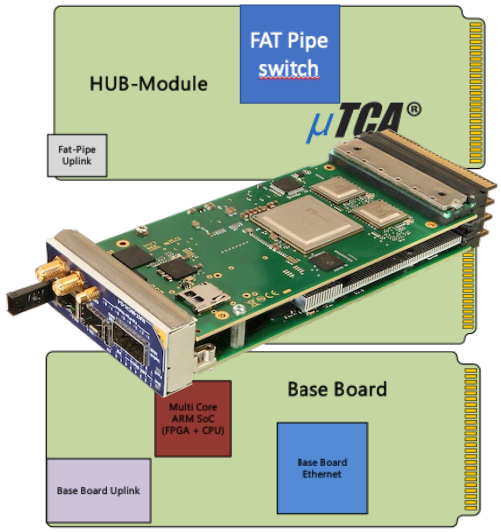
- New design providing new and improved functionality and optional features
  - Base MCH: Fabric A 10GbE, user core
  - CLK module: jitter cleaner, IEEE1588, optional OCXO and GPS
  - Ethernet Hub: 40/100GbE
  - PCIe Hub: PCIe gen5, optional optical uplinks
  - Harmonized CLI, new web interface
- Backward compatible with NAT-MCH Gen3
- Full form fit and function replacement
- Complies with MTCA.0 R3
- NextGen MTCA ready
- Open to future requirements

Main differences between Gen3 and Gen4 (excerpt)

	NAT-MCH Gen3	NAT-MCH Gen4 (improvements)
CPU + O/S + memory	Single core NXP Coldfire + OK1 + 64Mb	Dual ARM core (A9, Xilinx Zynq) + FreeRTOS + 1GB
Base Switch	Broadcom 1GbE	Microchip 1/10/40GbE, dual ARM core (A53)
Base Fabric + Uplinks	12x 1GbE + 2x 1GbE (RJ45)	12x 1/2.5/10GbE + 2x 1/10GbE (RJ45/iX/SFP-DD)
Clock Module + ext. Input/output	CLK123, CLK12F, CLK-PHYS + dual input/output	CLK-G4 + dual input/output and GPS
IEEE1588/SyncE + TSN support + OXCO	Not supported+ Not supported + NAMC-PTM	Supported + Supported + OCXO
Fat pipe Ethernet switch	Marvell Amstrong-LP 40GbE	Marvell Amstrong-LP 40GbE
Fat Pipe + Uplinks	12x XAUI + MPO	12x XAUI/10/40G + SFP-DD
Fat pipe PCIe Switch + PCIe Gen	PLX + Gen3	MicroChip + Gen4
Fat Pipe + Uplinks	12x PCIe Gen3 + Finisar BOA (NAT-MCH-PHYS80)	12x PCIe Gen4 + SFP-DD
Fat pipe SRIO Switch + SRIO Gen	IDT + Gen2	?
Fat Pipe + Uplinks	12x SRIO Gen2 + Infiniband	?
User Interfaces	CLI, Web (GoAhead) => Update with 2.22.x	unified CLI, reworked Web (Mongoose) incl. CLI
NATView: HPM update + backplane viewer + FRU-Ed	JRE on external device	Integrated into Web interface (excl. FRU-Editor)

NAT-MCH-G4 – generation 4 building blocks

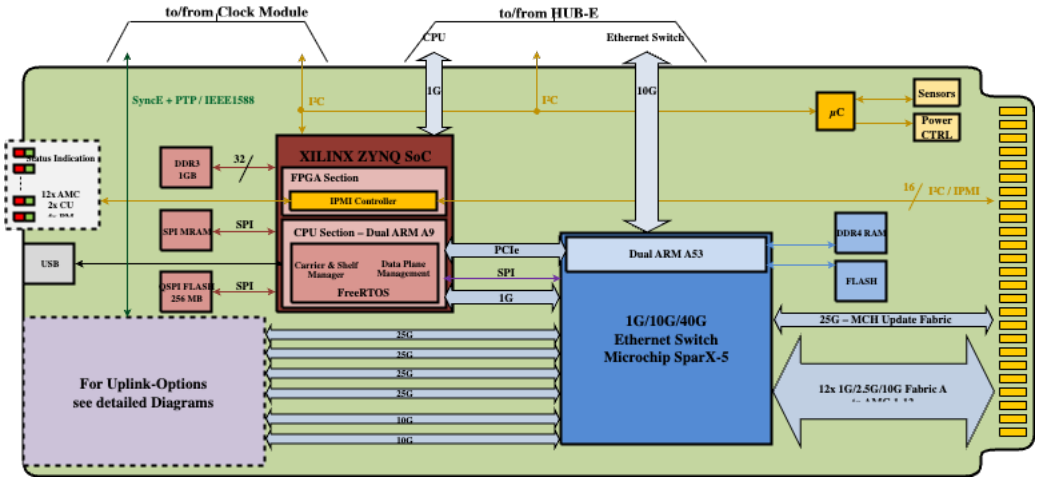
- Fat-Pipe HUB Modules
  - 1/10/40/100 GbE
  - PCIe gen4 (52-ports) + gen5 (84-ports)
  - QSFP/QSFP-DD uplinks for all Fat Pipes
- Clock-Module (IEEE 1588)
  - IEEE1588 support
  - Optional OXCO and GPS
  - Front panel I/O
- Base Board
  - Multi Core ARM SoC
  - Base Board Ethernet
  - Base Board Uplink



NAT-MCH Gen4

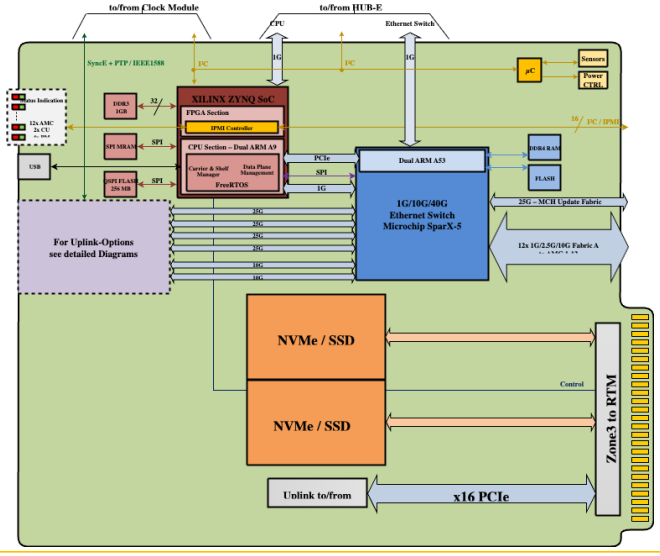
Base Boards

NAT-MCH-G4 (single-width base board)



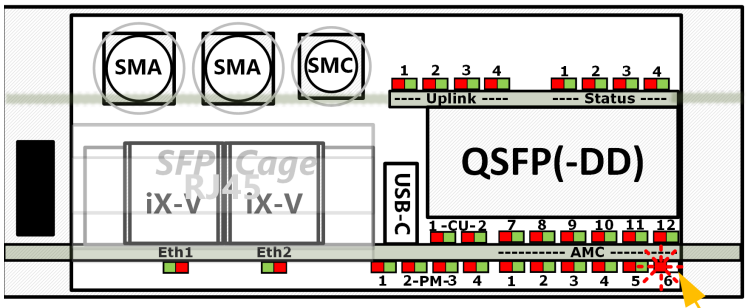
12

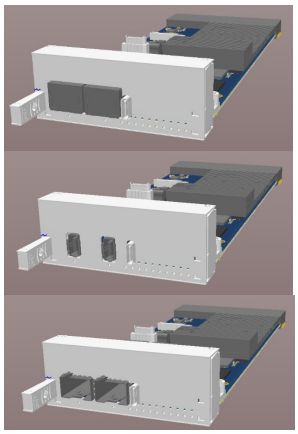
NAT-MCH-S4 (double-width base board)



13

NAT-MCH-G4 – front panel view



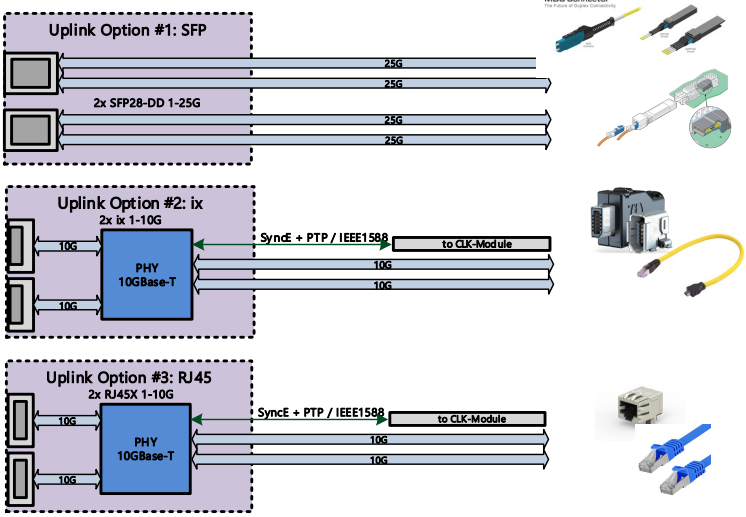


Fault AMC1

- USB-C for serial terminal: debug + info + configuration
- Basic status indication via red/green LED

Base Board Uplink three choices

- Option #1: **SFP(-DD)**
  - 1-25G
  - Optical / Copper via SFP
- Option #2: **ix**
  - 1-10G (10GBASE-T)
  - Copper
- Option #3: **RJ45**
  - 1-10G (10GBASE-T)
  - Copper



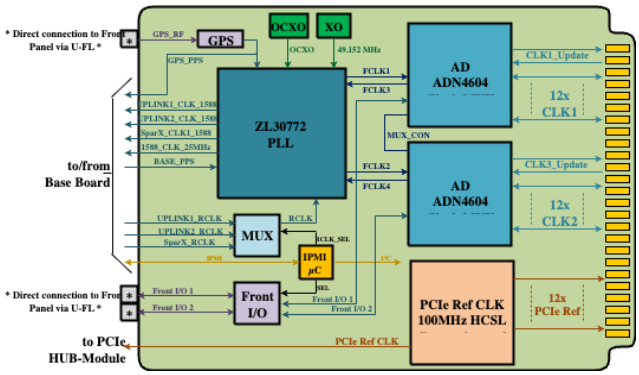
NAT-MCH Gen4

Clock Module

16

Clock Module

- PLL synthesizer and dedicated FPGA
  - several options of switching
  - Several option for clock manipulation
    - IEEE 1588 Support
    - Synchronous Ethernet Support
    - 2 low-Jitter Clock mux offer CLK1 + CLK2
    - 3rd mux for CLK3 or PCIe Reference Clock
    - GPS via SMA connector at front as option
    - Optional OCXO on Base Board



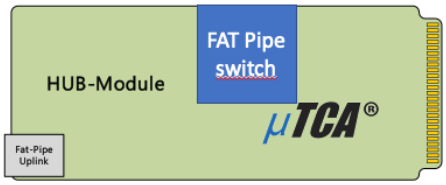
17

NAT-MCH Gen4

Fat Pipe Hub Modules

Fat pipe hubs

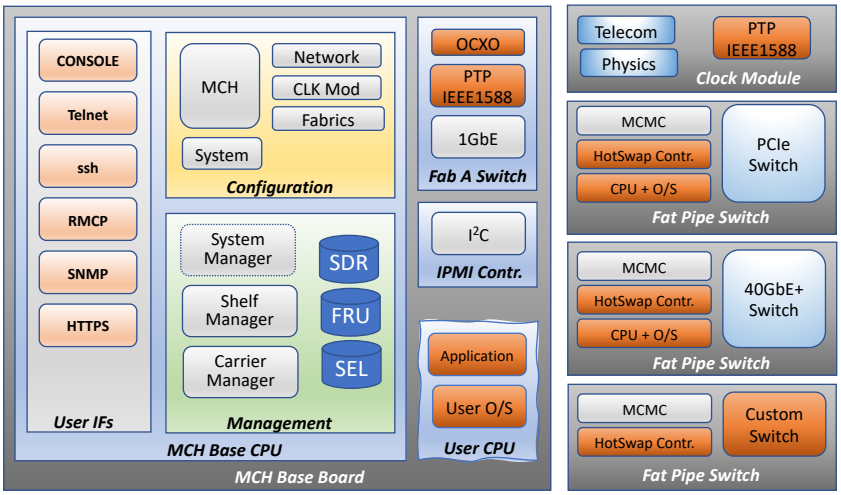
- HUB-EX (single-width)
  - 40/100GbE (still supporting XAUI)
  - Managed switch, Marvell Suite running on onboard CPU
  - QSFP-DD cage for uplinks up to 100GbE
- HUB-Px52 (single-width)
  - Microsemi PCIe gen4, 52 ports
  - QSFP cage for uplinks (x4)
- HUB-Px84 (double-width)
  - Microsemi PCIe gen5, 84 ports
  - QSFP-DD cage for uplinks (x8+x8 or x16)



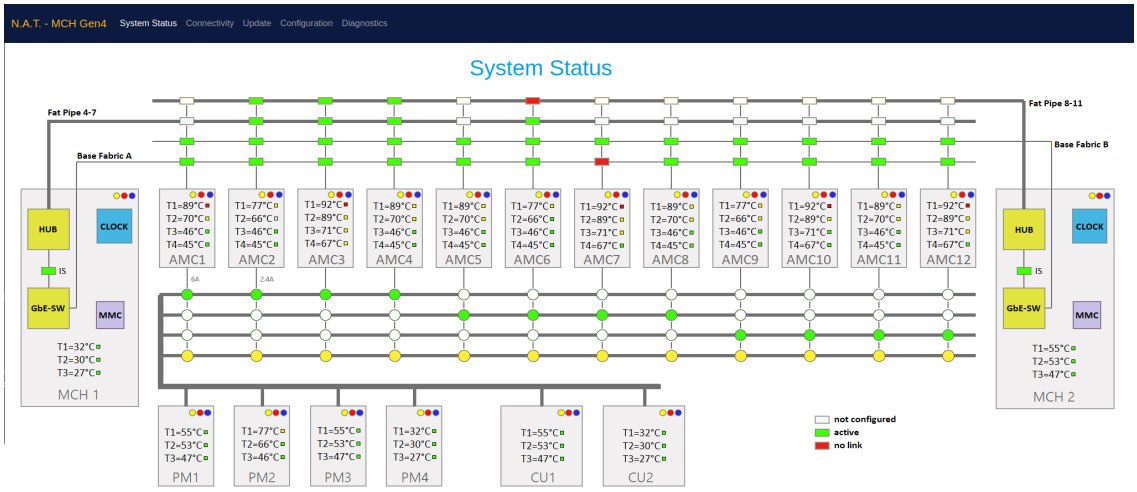
NAT-MCH Gen4

Firmware

NAT-MCH Gen4 function blocks and compatibility



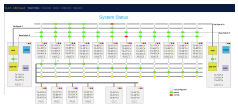
Software interfaces of Gen4 base board web interface



22

Software interfaces of Gen4 base board overview

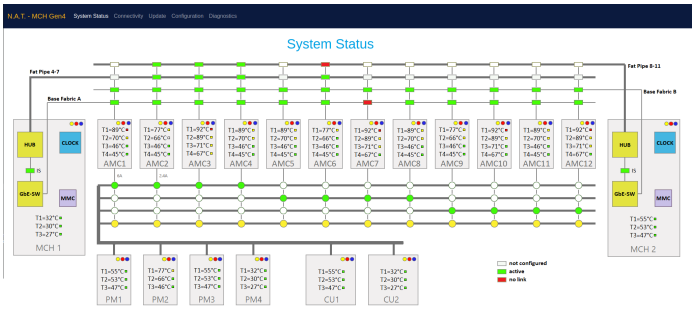
- Improved software interfaces with Gen4 base board.
  - Webinterface with a new look

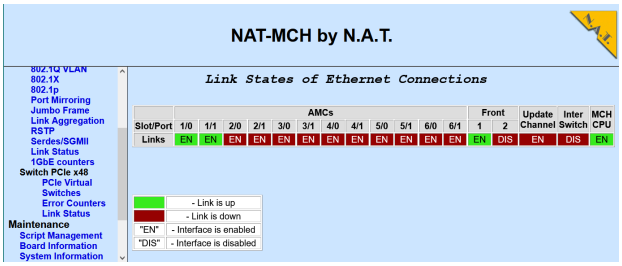


  - Command Line Interface with new syntax
    - Currently a combination of CLI and interactive mode
      - `fan_ctl -> 3 -> 1 -> 4`
      - `show_fruinfo 50`
    - Shall be unified to keyword driven CLI like `set`, `get`, `print`
      - `Syntax: <keyword><function><opt.sub function><fruId><opt.param>`
        - `set fan level 40 4`
        - `get fan level 40 -> nat> 4`
        - `print fruinfo 50`

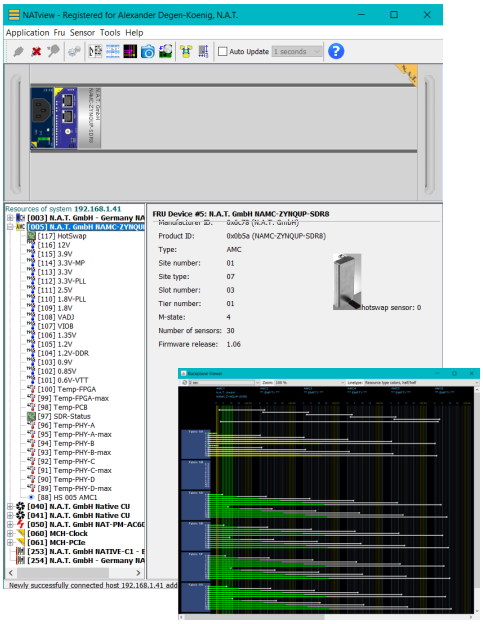
23

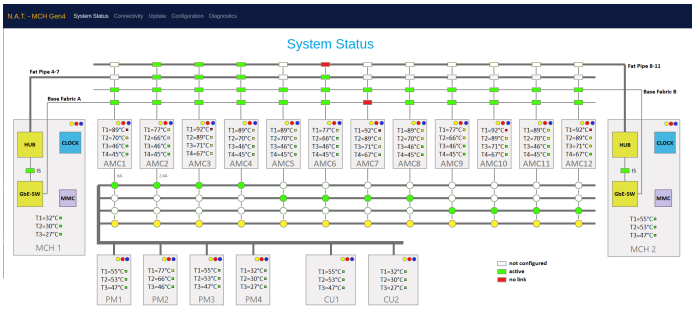
```
nat> print sensorinfo 5

Sensor Information for FRU 5 / AMC1
============================================================
  #   SDRType  Sensor Entity Inst  Value    State    Name
------------------------------------------------------------
  -   MDevLoc          0xc1  0x61           NAMC-ZYNQUP-FMC
  1   Compact  0xf2    0xc1  0x61  0x01             HotSwap
  2   Full     Voltage 0xc1  0x61  12.361 V  ok     12V
  3   Full     Voltage 0xc1  0x61  3.870 V   ok     3.9V
  4   Full     Voltage 0xc1  0x61  3.359 V   ok     3.3V-MP
  5   Full     Voltage 0xc1  0x61  3.345 V   ok     3.3V
  6   Full     Voltage 0xc1  0x61  3.303 V   ok     3.3V-PLL
  7   Full     Voltage 0xc1  0x61  2.497 V   ok     2.5V
  8   Full     Voltage 0xc1  0x61  1.802 V   ok     1.8V-PLL
  9   Full     Voltage 0xc1  0x61  1.794 V   ok     1.8Vm
```





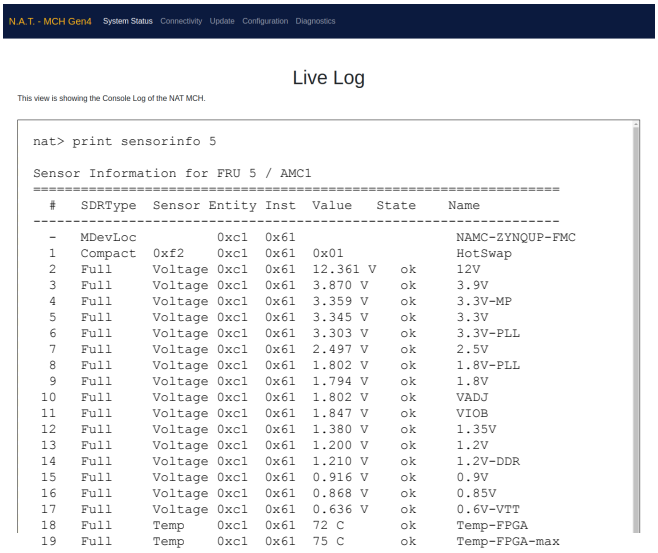
- combine web interface and CLI:
  - print fru , print fruinfo 5
  - print linkstate , print ports
  - print sensorinfo 5

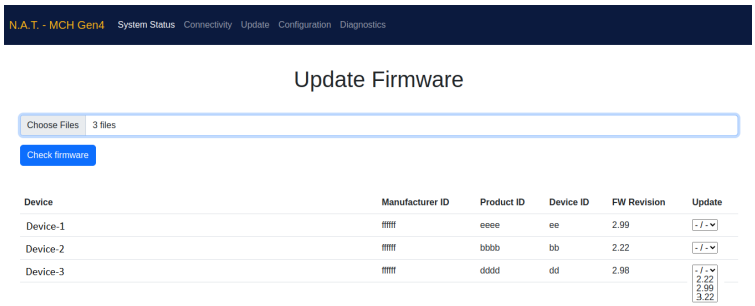




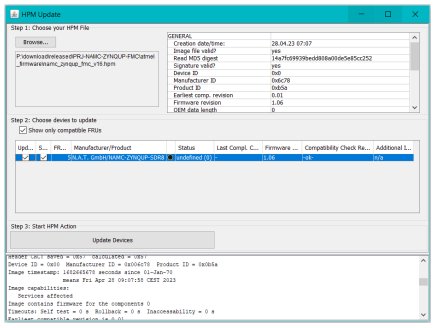
- combine web interface and NATview:
  - backplane viewer
  - sensor readings
  - real-time link state
  - (NATview will remain)

- Live Log:
  - shows log messages
  - contains complete functionality as CLI via console or telnet
  - additional filter capabilities





- select multiple hpm files
- files are checked against the compatibility list
- choose any FRU device and FW versions to update



Mongoose web server – by Cesanta Software ltd.

- small footprint cross-platform embedded web server
  - for Linux, Windows, FreeRTOS …and generally easy portable
  - for every BSD API netwok stack e.g. LwIP, FreeRTOS-Plus-TCP
- extensively tested
  - 18 years on the market – 100M+ devices deployed
  - used by hundreds of businesses
- secure and up-to-date
  - continuous integration test powered by GitHub
  - Google's oss-fuzz scans for potential vulnerabilities
  - periodic vulnerability reports from groups like Cisco, Microsoft, NASA
- feature rich
  - Plain TCP/UDP, HTTP, MQTT, Websockets, SSL/TLS by mbedTLS or OpenSSL

28

Summary

- Why NAT-MCH Gen4?
  - New functions and requirements
  - MTCA.0 Rev 3
  - Upcoming component obsolescence with NAT-MCH Gen3
  - NAT-MCH Gen3 will reach EOL soon, LTB in 2025 and LTS in 2025/2026
- How to migrate and when?
  - NAT-MCH Gen4 is a full form, fit and function replacement for NAT-MCH Gen3
  - Migration is expected to be smooth and easy
  - Customers may encounter minor changes in CLI when using shell scripts
  - Customers started migrating already
  - Migration is expected to be finished 2025

29

Thank you very much!

Heiko Körte
Director Sales & Marketing
heiko.koerte@nateurope.com

N.A.T. GmbH
Konrad-Zuse-Platz 9
53227 Bonn
Germany

www.nateurope.com

Repository

PICMG – Next Generation MicroTCA

- New PICMG work group "Next Generation MicroTCA"
  - Since end of 2019
  - Members represent
    - Manufacturers
      - Chassis (incl. cooling and backplane)
      - Power Modules
      - MCHs
      - AMCs
      - Mechanical components such as connectors
      - Semiconductors
    - Users
  - Goal
    - Improve MicroTCA so that it can meet the requirements for the **next 10-15 years**
    - Keep next generation of MicroTCA backward compatible
  - Intermediate step
    - MicroTCA v3 adopted in December, 2023
  - Next Step: Next Generation spec.