White-Rabbit for MTCA.4

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White Rabbit for MTCA.4
Agenda

- Introduction N.A.T.
- Motivation of White-Rabbit on MCH
- Current Status
- Comparison AMC-psTiming-Module
- Summary

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About N.A.T.
Network and Automation Technology

Vollrath Dirksen
White-Rabbit for MTCA.4

- 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
- Presenter:
  - Dipl. Ing. Vollrath Dirksen, vollrath@nateurope.com

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About N.A.T.
Product Portfolio
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- 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

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4 3 2 1 AMC1 AMC2 AMC3 AMC4 AMC5 AMC6 AMC7 Port

Common Options

MCH1 Fabric [A] to AMC Port 0

MCH1 Fabric [A] to AMC Port 1

AMC Port 2

AMC Port 3

Fat Pipe

MCH1 Fabric [D:G] to AMC Port [4:7]

Ext. Fat Pipe

Extended Options

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

1GbE

SAS/ SATA

PCIe

1GbE/ SRIO

Point-2-point links

TCLK/D

Triggers, Clocks Interlocks

Motivation
AMC-White-Rabbit -> MCH-White-Rabbit

- Save one AMC slot
- Status of AMC design to shrink it to a sub-module size for MCH
- Discussion to design complete MCH or deliver submodule
  - Standard-MCH:
    - Ensures interoperability with nearly all MTCA and AMC components
    - shorter delivery time and quicker acceptance
- Additional functionality

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White Rabbit

Focus

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- Sub-nanosecond accuracy:
  - synchronization of more than 1000 nodes via fiber or copper connections of up to 10 km of length.
- Flexibility:
  - creates a scalable and modular platform with simple configuration and low maintenance requirements.
- Predictability and Reliability:
  - allows the deterministic delivery of highest priority messages by using Class of service.
- Robustness:
  - no losses of high priority system device control messages.
- Open source hardware and software:
  - to avoid vendor lock-in.

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WR-DDS-RF principle

NAT-MCH-CLK-WR

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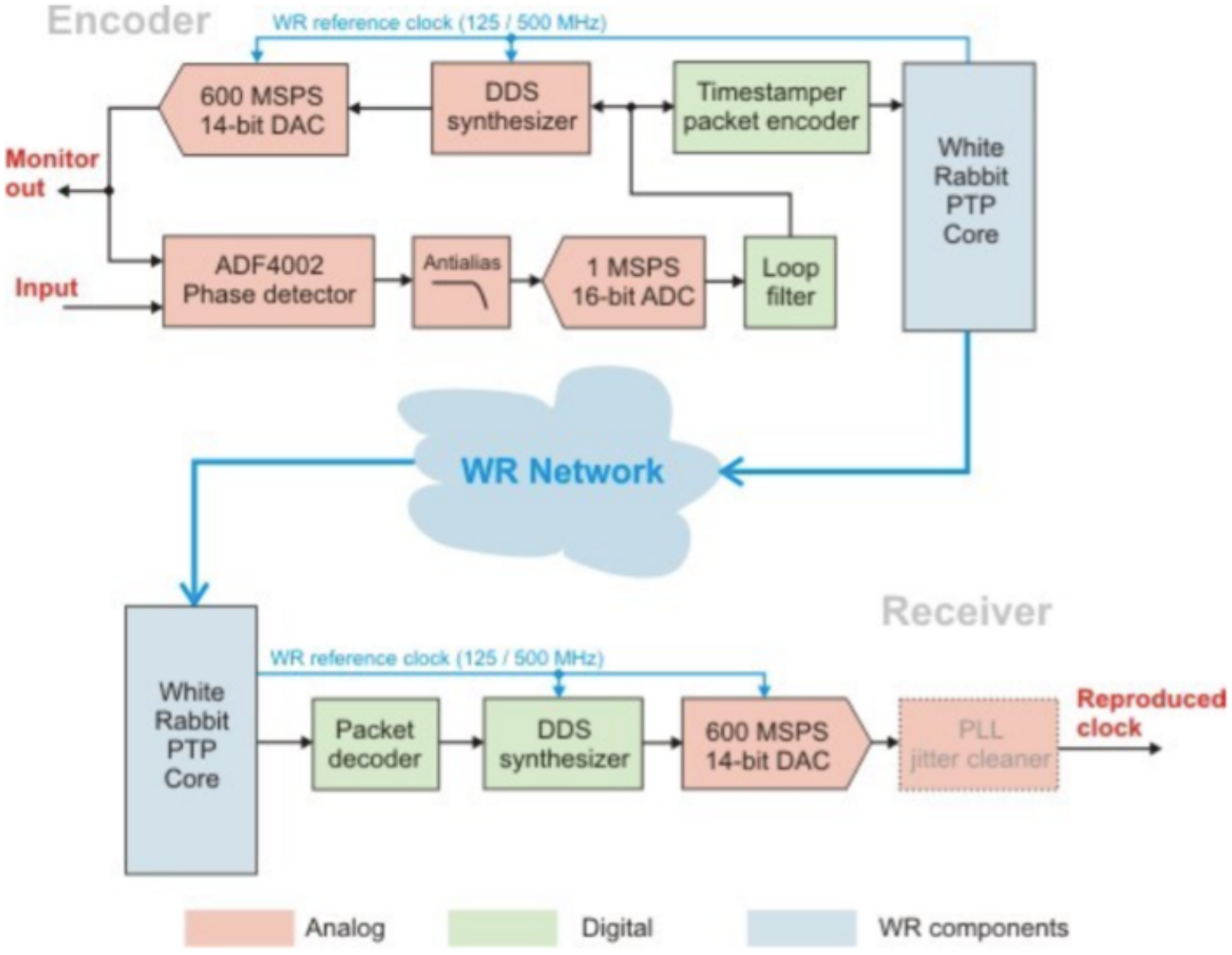

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White Rabbit

NAT-MCH-CLK-WR

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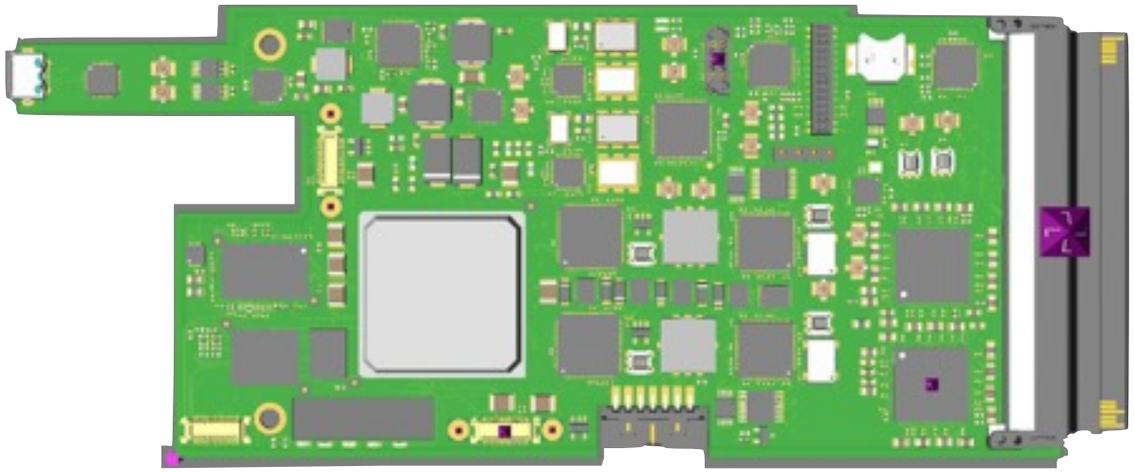

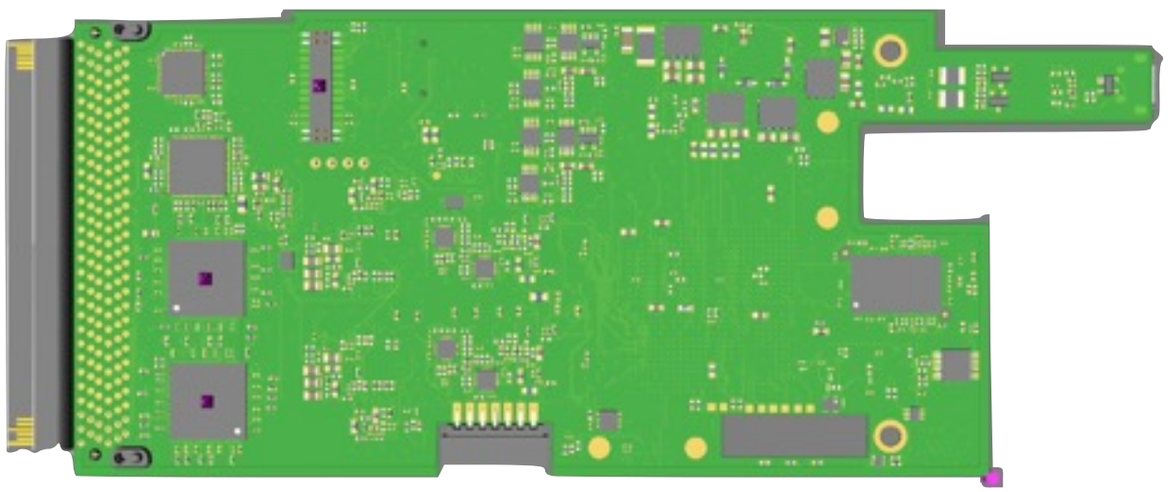

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Select MCH

NAT-MCH-Base12-GbE or NAT-MCH-M4

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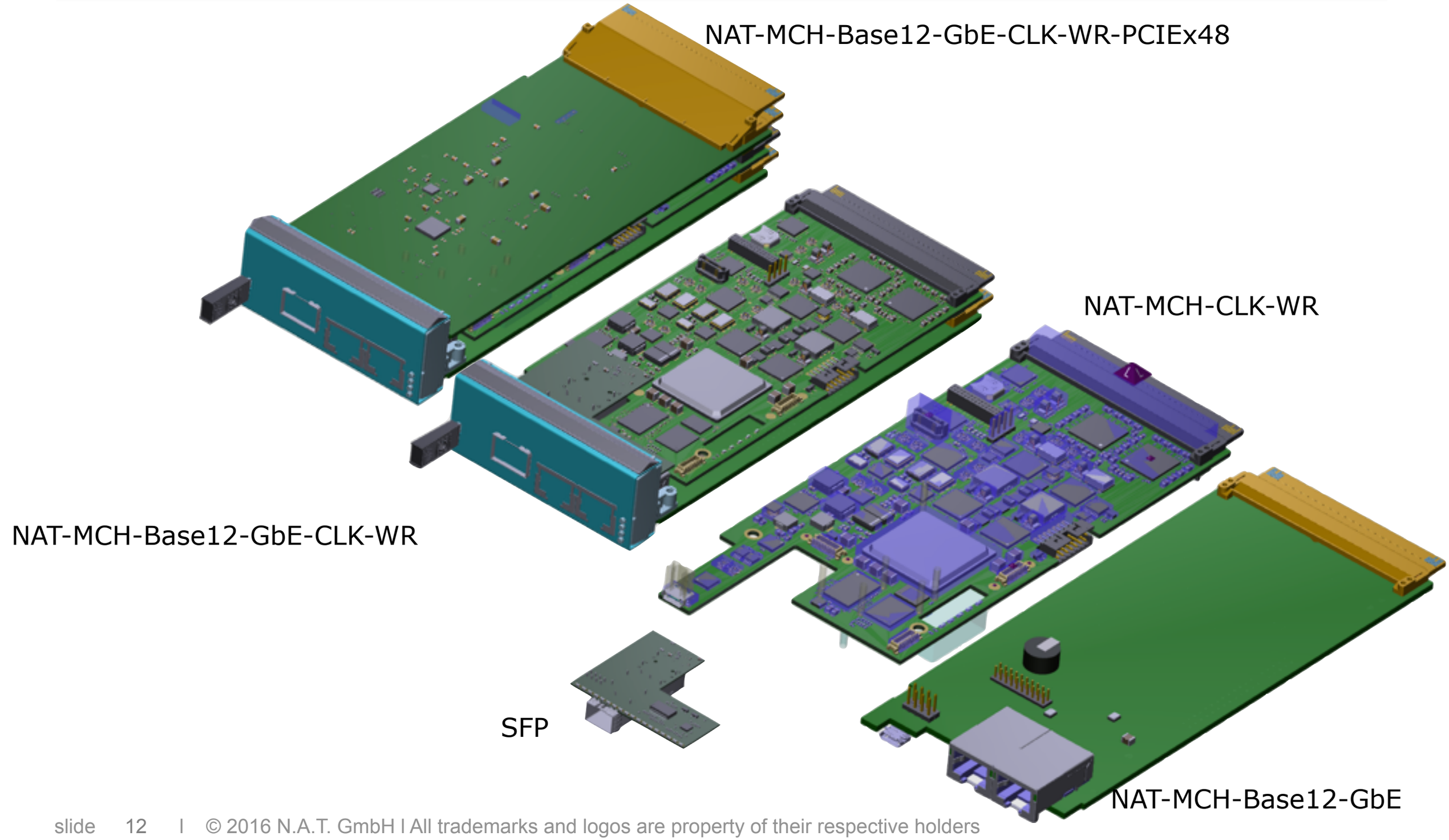

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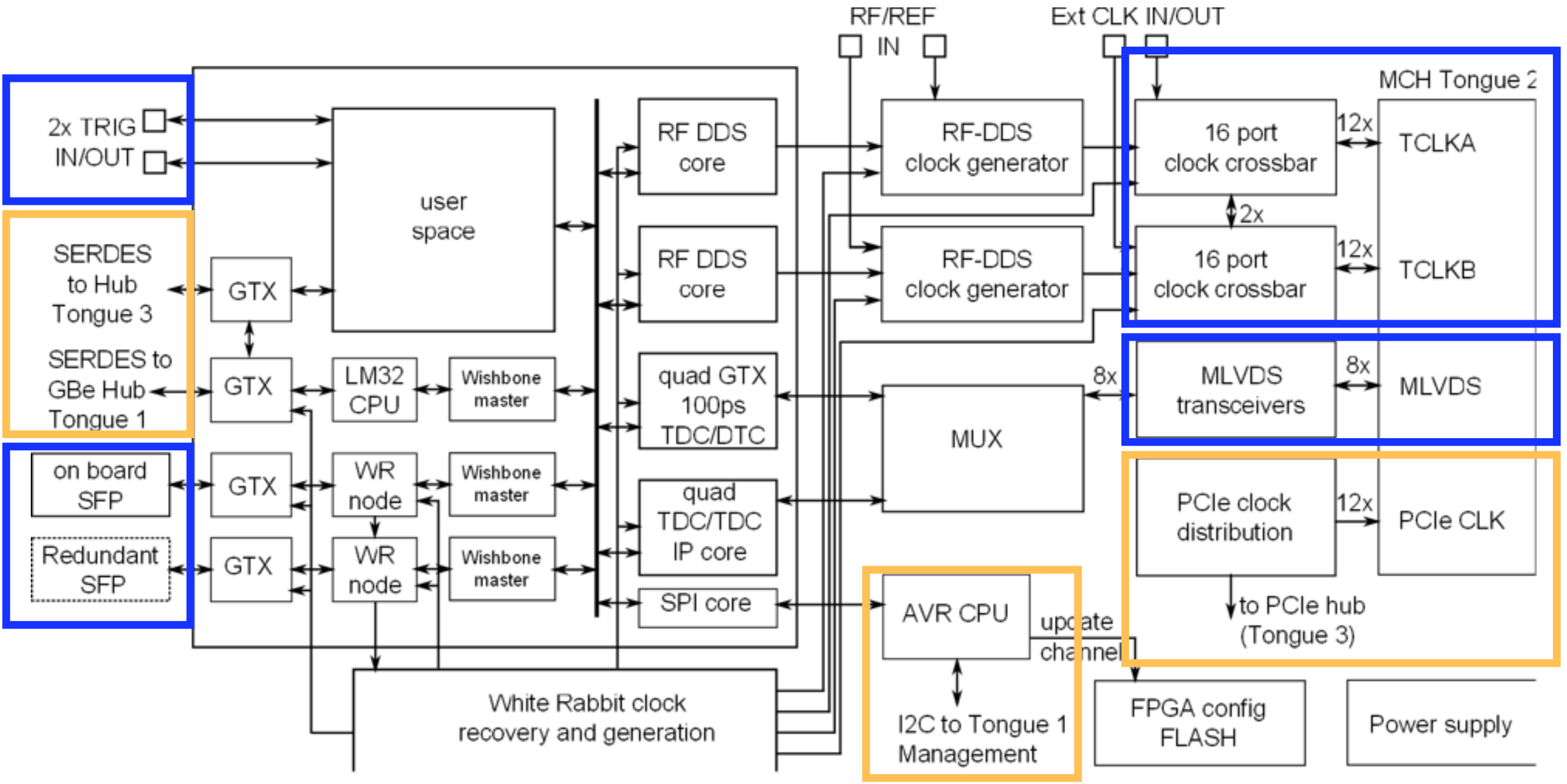

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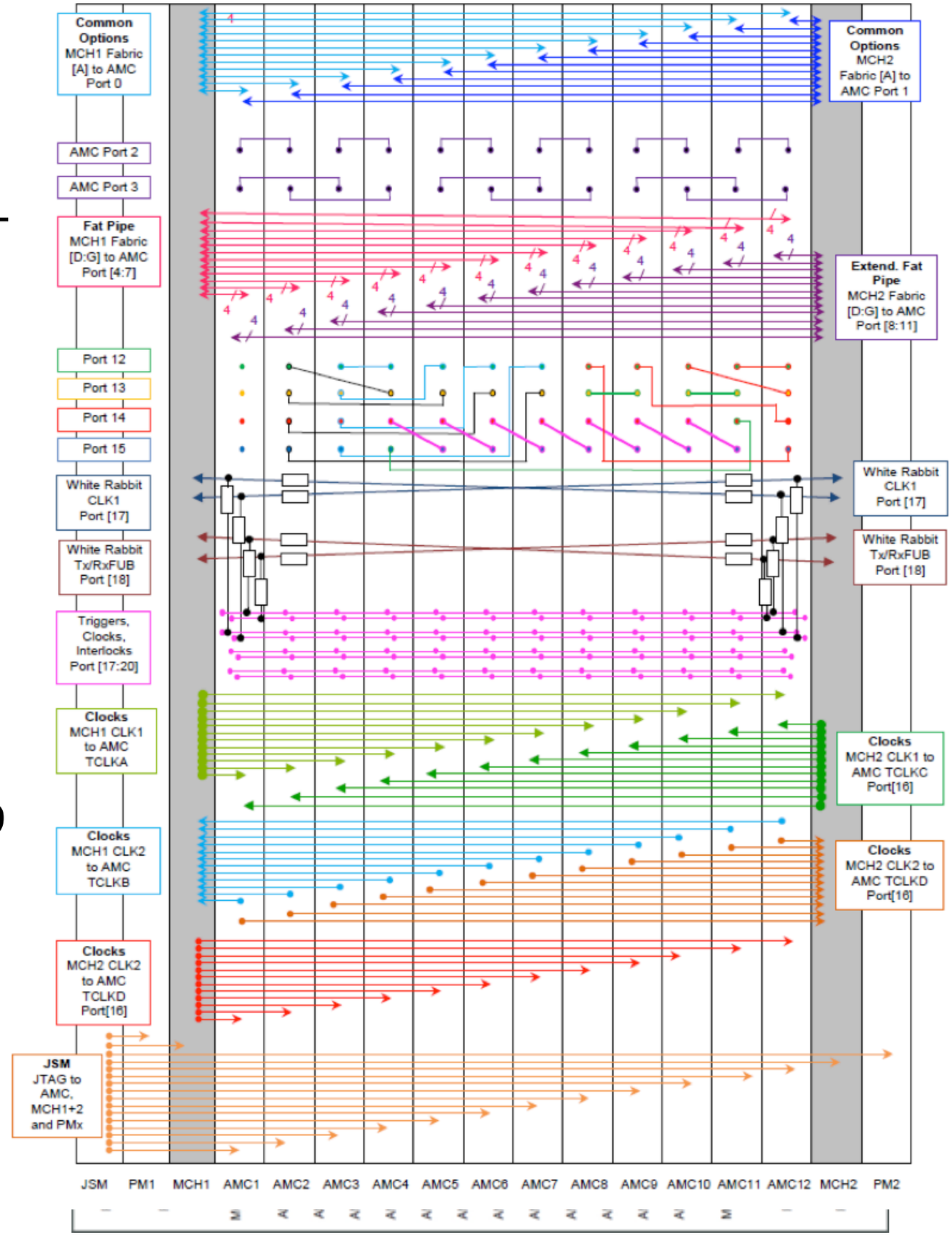
NEW NATIVE-R9

White-Rabbit-Support

- Available Chassis
  - NATIVE-R2
  - NATIVE-R9

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

old NATIVE-R9



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NAT-MCH-CLK-WR

Status

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- Probably first installation will be in GSI at the FAIR/CBM experiment
- The timing module specification changed a little after we got feedback from potential users
- Main changes:
  - replacement of FPGA by ZynQ
  - fully redundant WR receiver (not only MAC)
  - additional clock paths and jitter cleaners.
  - Management interface also changed
    - since ZynQ is on board, we can run web interface directly on it
- Project Status:
  - Review of schematics by N.A.T.
  - Review of schematics as pdf by White Rabbit Community

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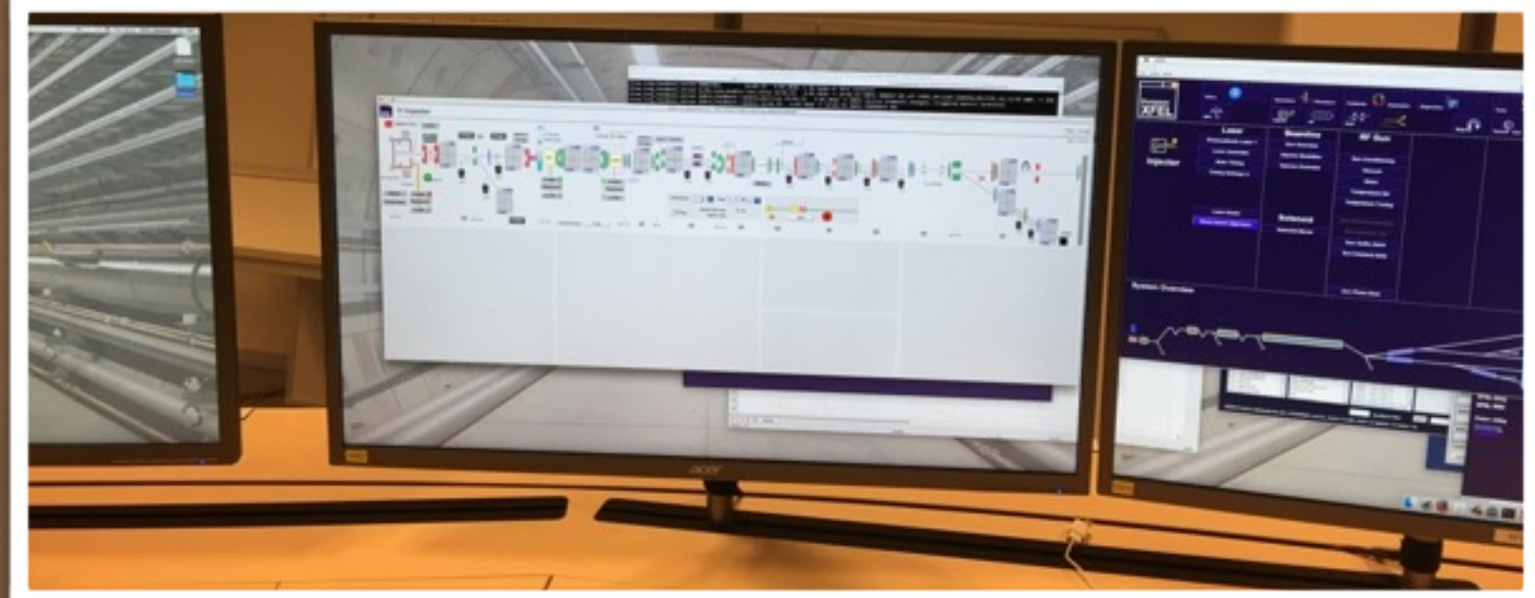
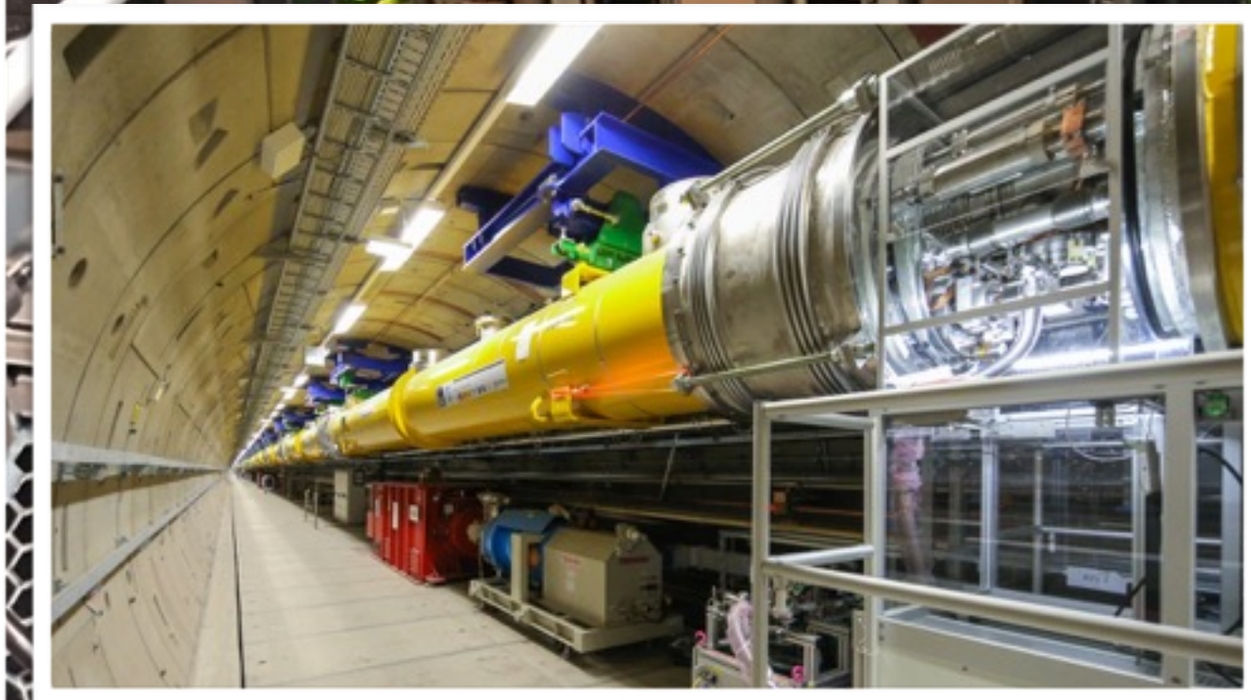
N.A.T. at and in DESY XFEL





NAMC-psTimer

Installation Example

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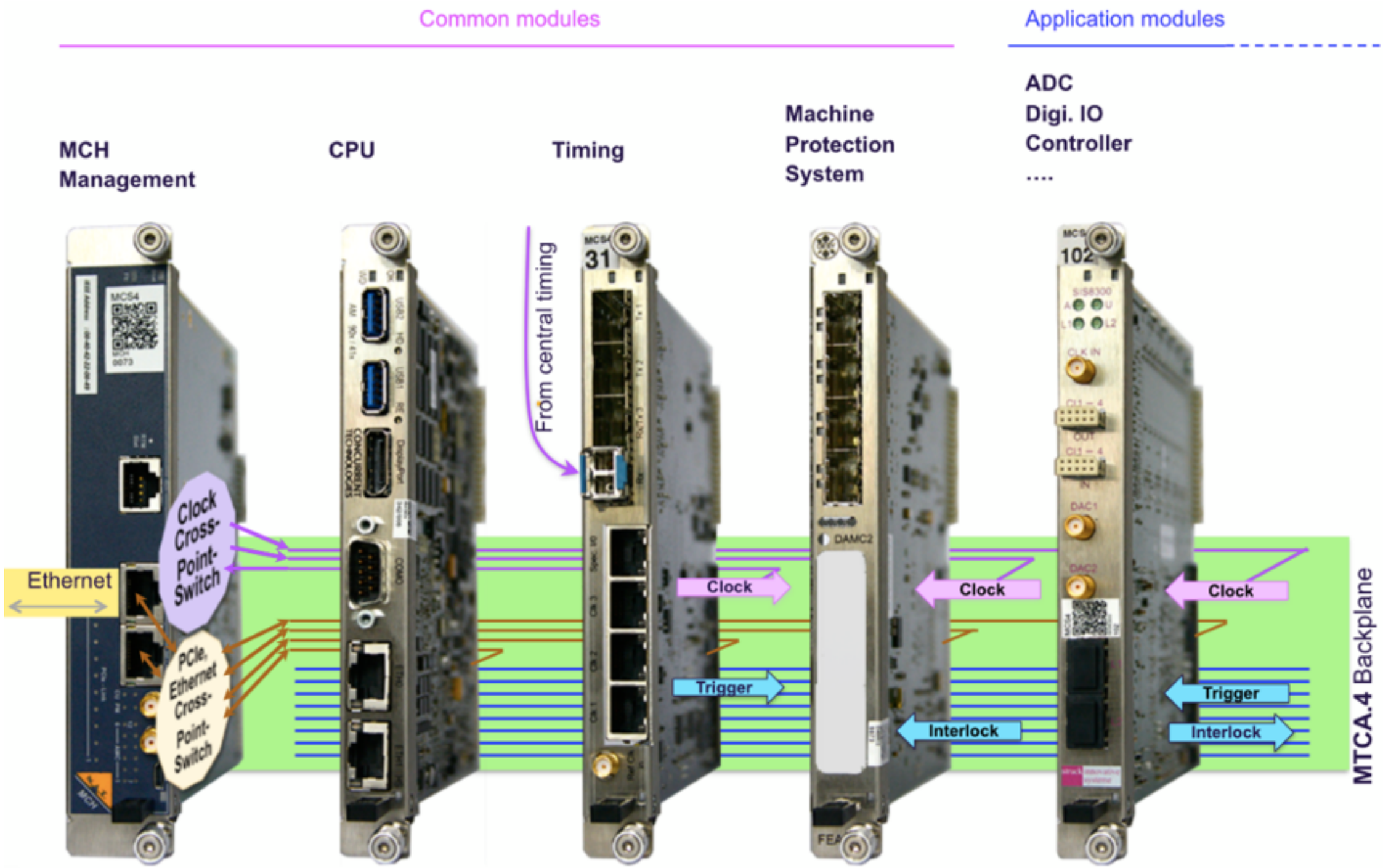

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NAMC-psTimer

AMC Fast Timing System with pico-second Resolution

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- Double, mid-size AMC for MTCA.4 systems
- pico-second stable clock and trigger **distribution and receiving** system
  - Clocks and triggers are programmed & generated by a master module
  - distributed in a multi-star topology
- All triggers within the entire timing system are synchronized with a jitter of approximately 10ps.
- The receiver has 23 programmable outputs:
  - trigger with delay
  - immediate or delayed trigger events
  - gates between trigger events
  - slow clocks
  - two different slow data protocols
  - fast data protocol
- References for timing systems
  - large installation at European XFEL (X-Ray Free Electron Laser)
  - 365/24h installation at FLASH, no problems

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NAMC-psTimer

AMC Fast Timing System with pico-second Resolution

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- Key Features:
  - can be used as a transmitter or receiver or gateway module
  - delivers precision clocks on TCLKA and TCLKB
  - provides triggers, gates, clocks or data on M-LVDS ports 17 - 20 in an MTCA.4 backplane
  - 3x RJ45 outputs at front panel with 2 triggers and one precision clock as LVDS signals
  - trigger position: 0 .. 160ms delay, 1ns resolution
  - trigger width: 0 .. 160ms, 10ns resolution
  - up to 255 trigger event numbers
  - precision clocks: 2.5 .. 650MHz
- Applications:
  - Diagnostic, Controls and Experiments
  - other distributed systems requiring very precise clock and trigger distribution, synchronous with for example the 1.3 GHz system RF-frequency, over distances of more than 3.4 km
  - Single stand-alone systems requiring high precise clock and trigger

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Block Diagram

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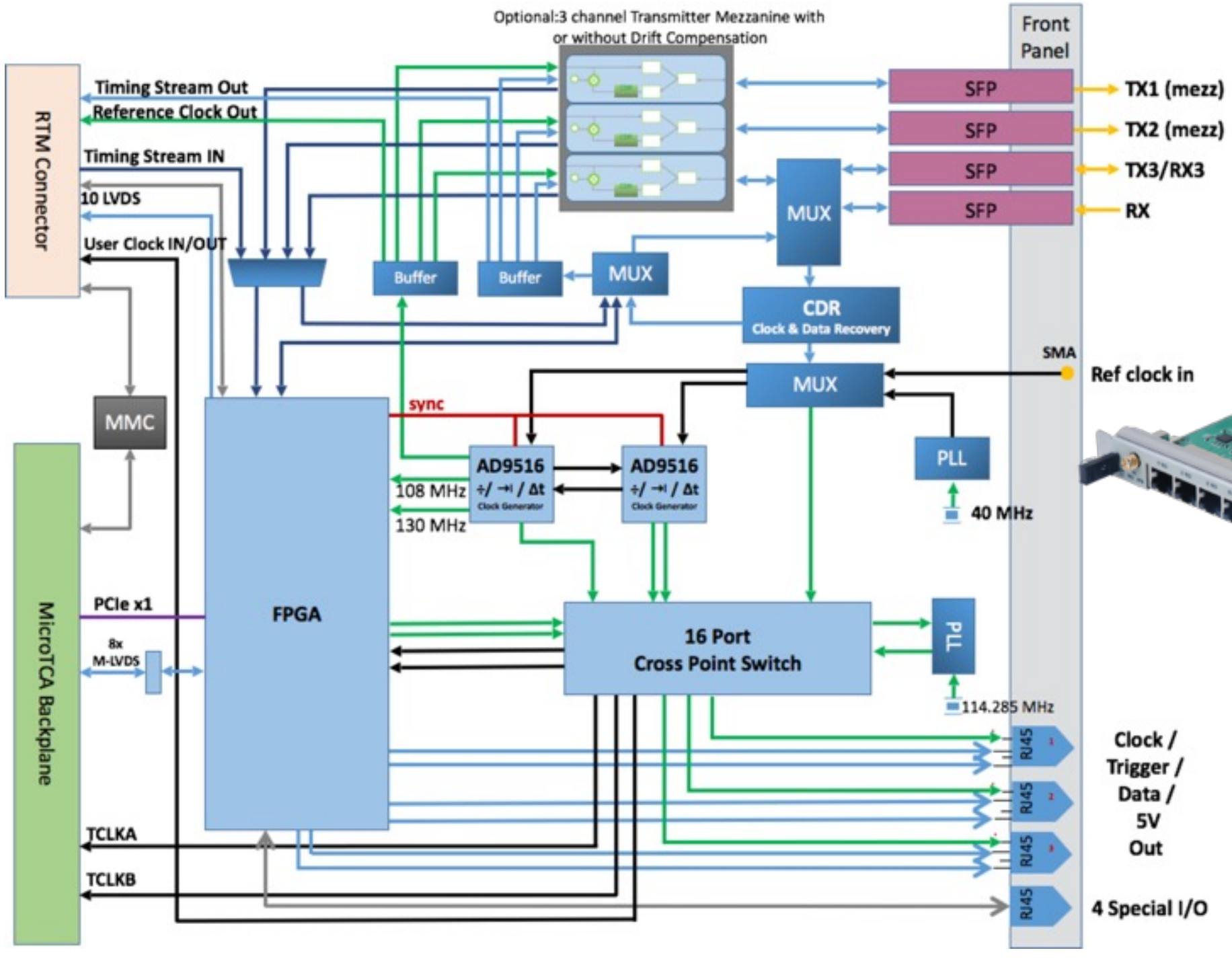

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Synchronisation simplified

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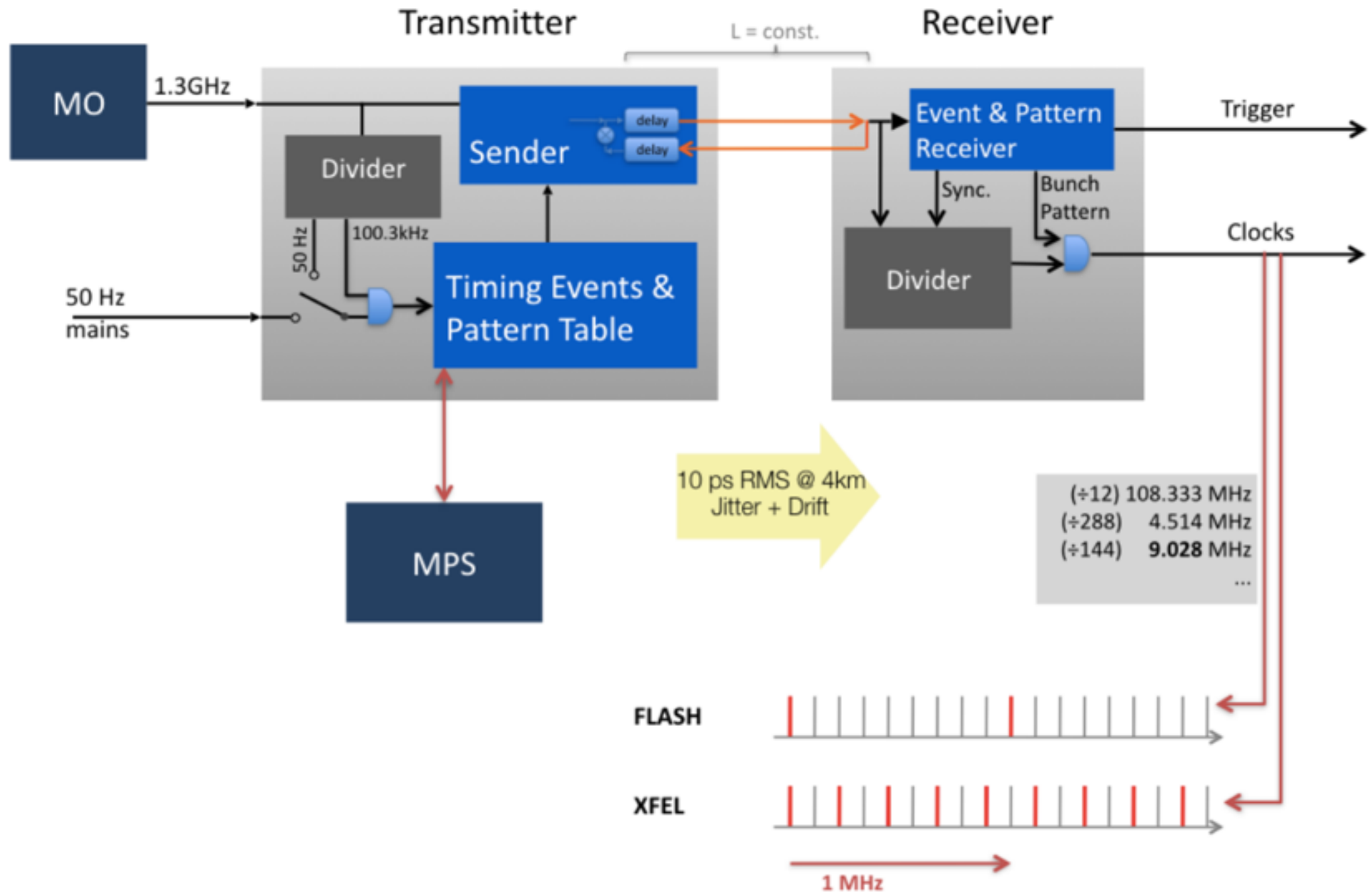

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Timing for the Injector Laser

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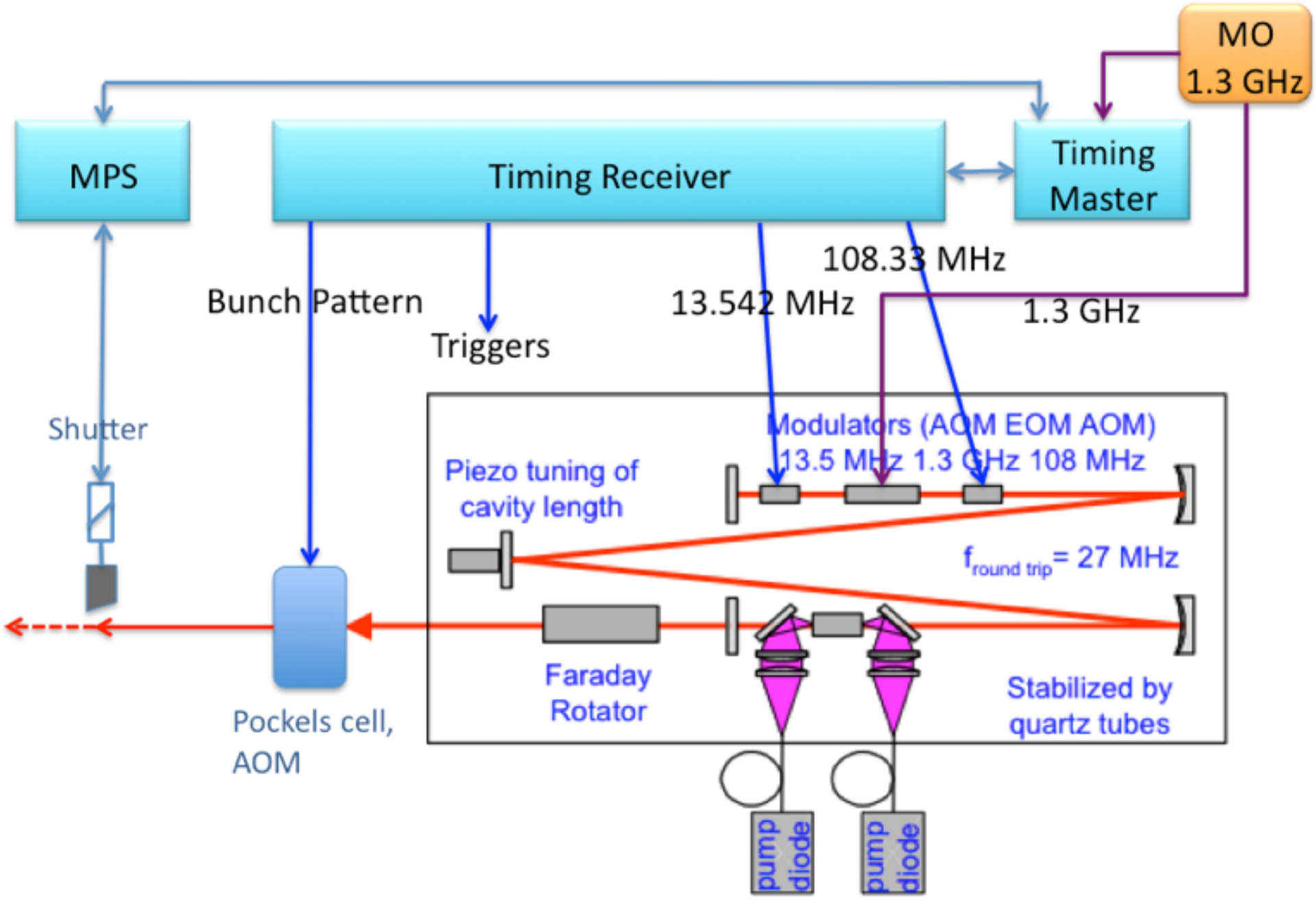

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NAMC-psTimer

More Information and Application

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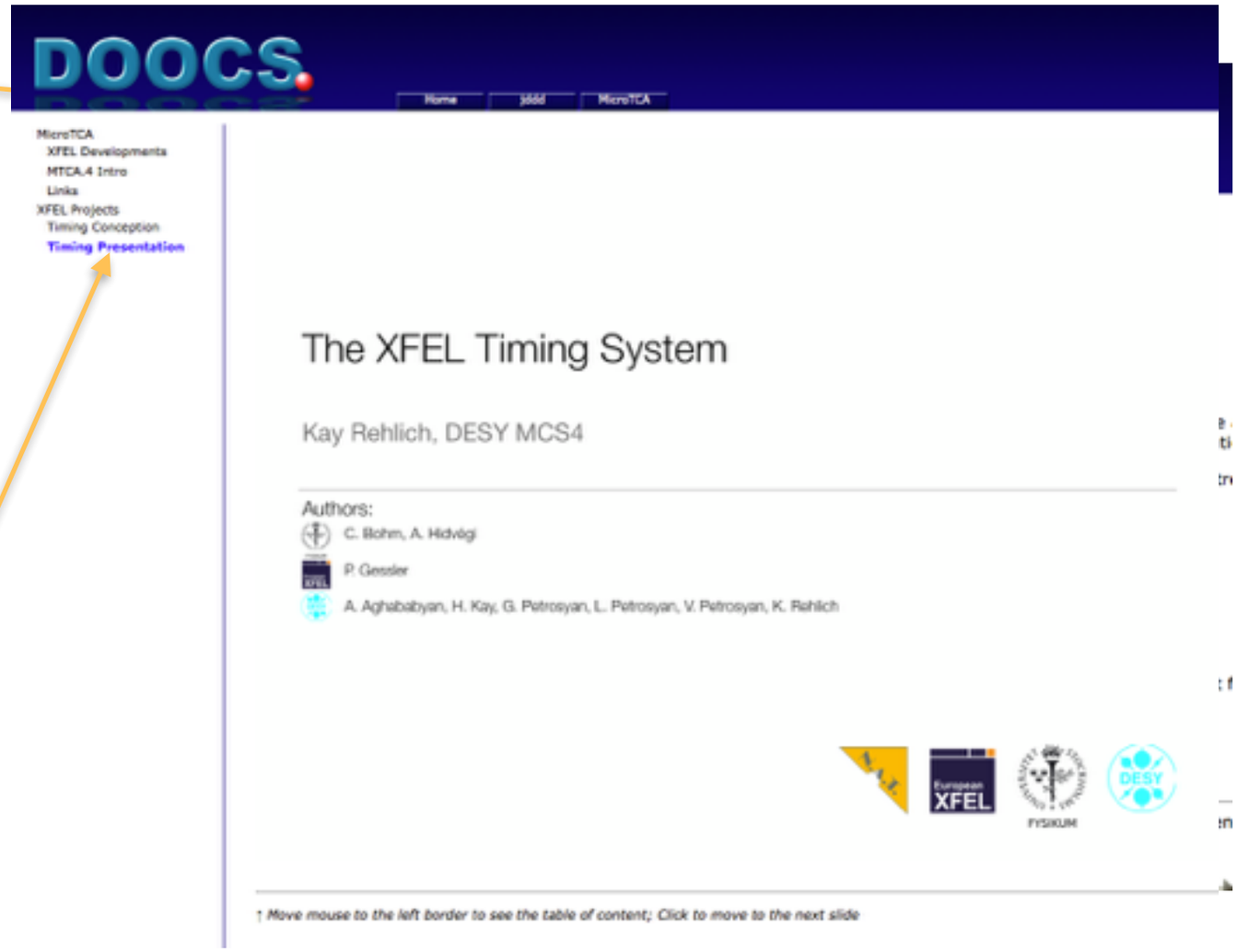
- https://doocs.desy.de
  - select MicroTCA
- MicroTCA
  - XFEL Developments
  - MTCA.4 Intro
  - Links
- XFEL Projects
  - **Timing Conception**
  - **Timing Presentation**



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Summary

- NAT-MCH-CLK-WR
  - mainly CERN and FAIR projects
  - need special external White-Rabbit-Ethernet Switches
  - does not consume any AMC slot
  - Competition:
    - Vadatech announced start of development of WR-Support for MCH
    - Samway/Elma have WR support for MCH but do not understand FPGA image

- NAMC-psTimer = x2Timer
  - same hardware used as transmitter and receiver
  - very flexible and powerful (up to external 9 + 4 trigger and clock lanes)
  - can distribute any data for example precise real time clock data
  - any application with need for precise timing information
  - FUTURE: may become also a MCH special clock module dependent on market request and success of White Rabbit MCH module

- MRF-Timer
  - expected to be used in ESS

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Questions

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Danke
Thanks
Arigatô
Toda
Tack
Merçi
Xièxie
Graçias
Dhanyavad
Gamsahamnida

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