

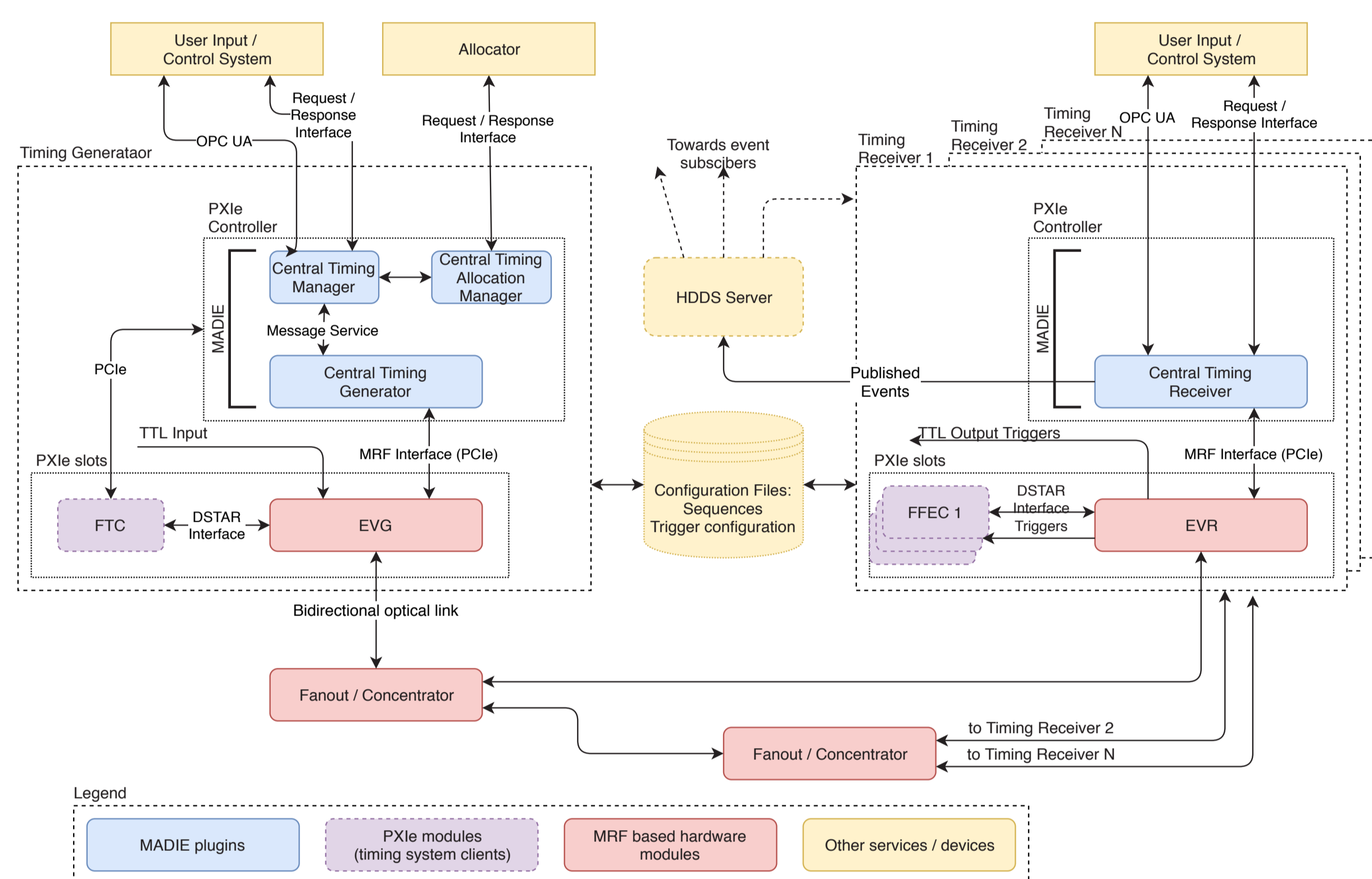
# CTS - Central Timing System

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## Abstract

The Central Timing System (CTS) is a specialized system intended to synchronize the operation of hundreds of devices distributed across the whole accelerator with great temporal accuracy. CosyLab's MRF-based timing system is an off-the-shelf product, adaptable to the needs of PT accelerators of varying type and size.

## System Schematics



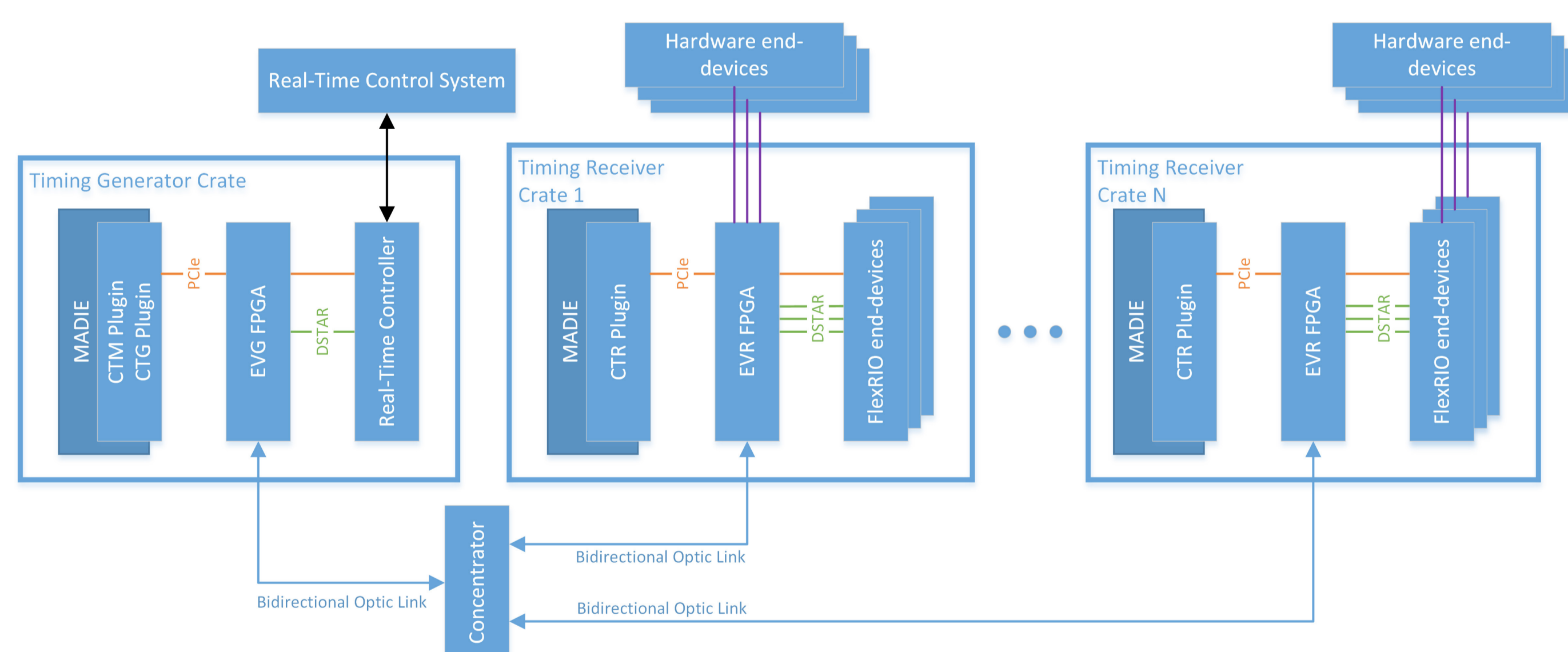
## Key features

The main features of the Central Timing System are:

- Developed as a MADIE plug-in for seamless integration with other devices developed in the same framework. Supports standard interfaces including **interfaces to medical systems** and a variety of SCADA systems.
- Provides a **central source of clock, triggers and time for synchronizing operation of devices and precise data timestamping**.
- **Distributed and scalable** system capable of running a virtually limitless number of receivers and ensuring that all timing receivers are phase-locked to the timing generator with no phase drift.
- **Real-time data distribution** enabling fast energy switching. Data is transmitted in real time to the end devices, thus allowing fast reconfiguration of the devices.
- **Real-time control** using the NI FlexRIO modules, CosyLab provides an API for seamless integration to the customer's real-time control system.
- **Fast acknowledging** mechanism ensures **speed and reliability** during **medical treatments**, where lowering energy switching time directly impacts the treatment time, increasing overall patient throughput.

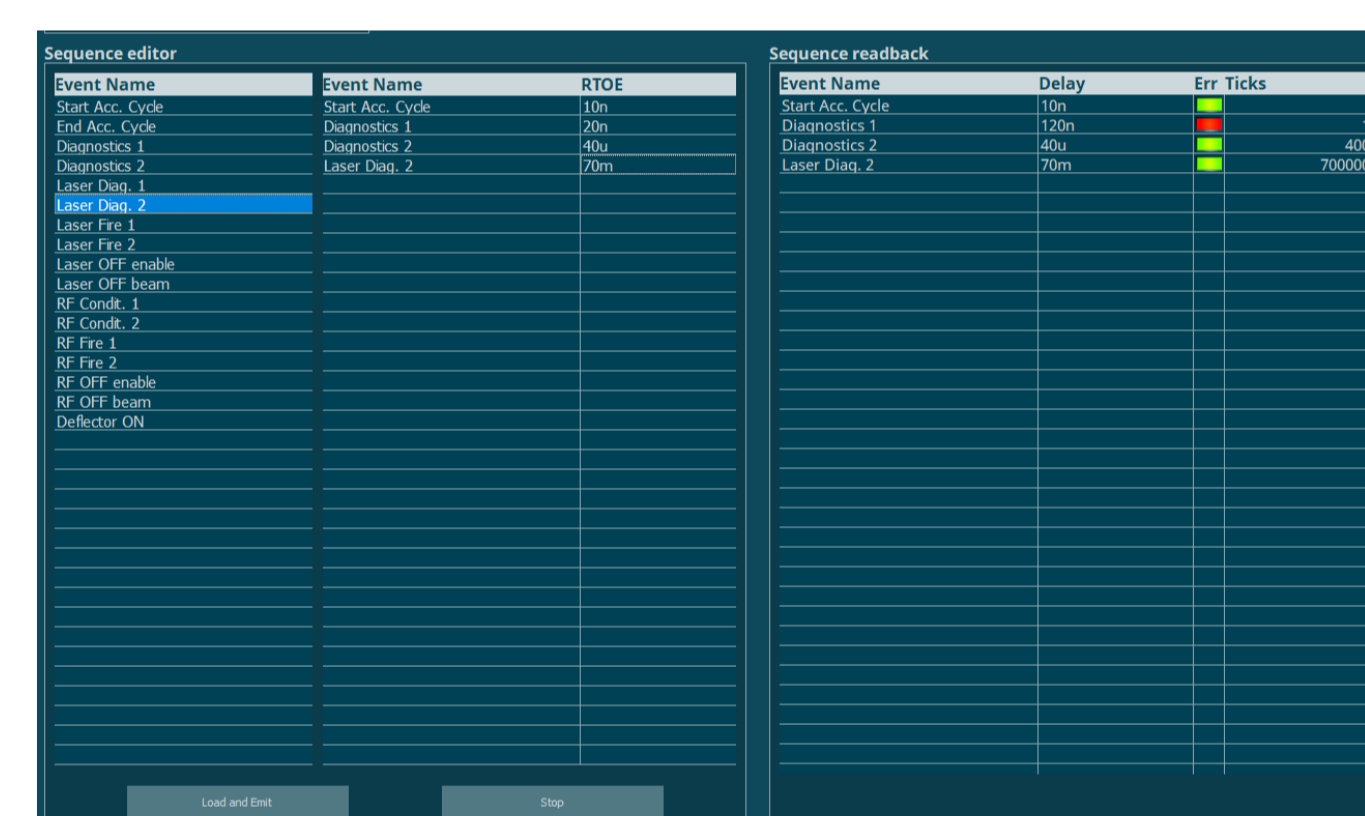
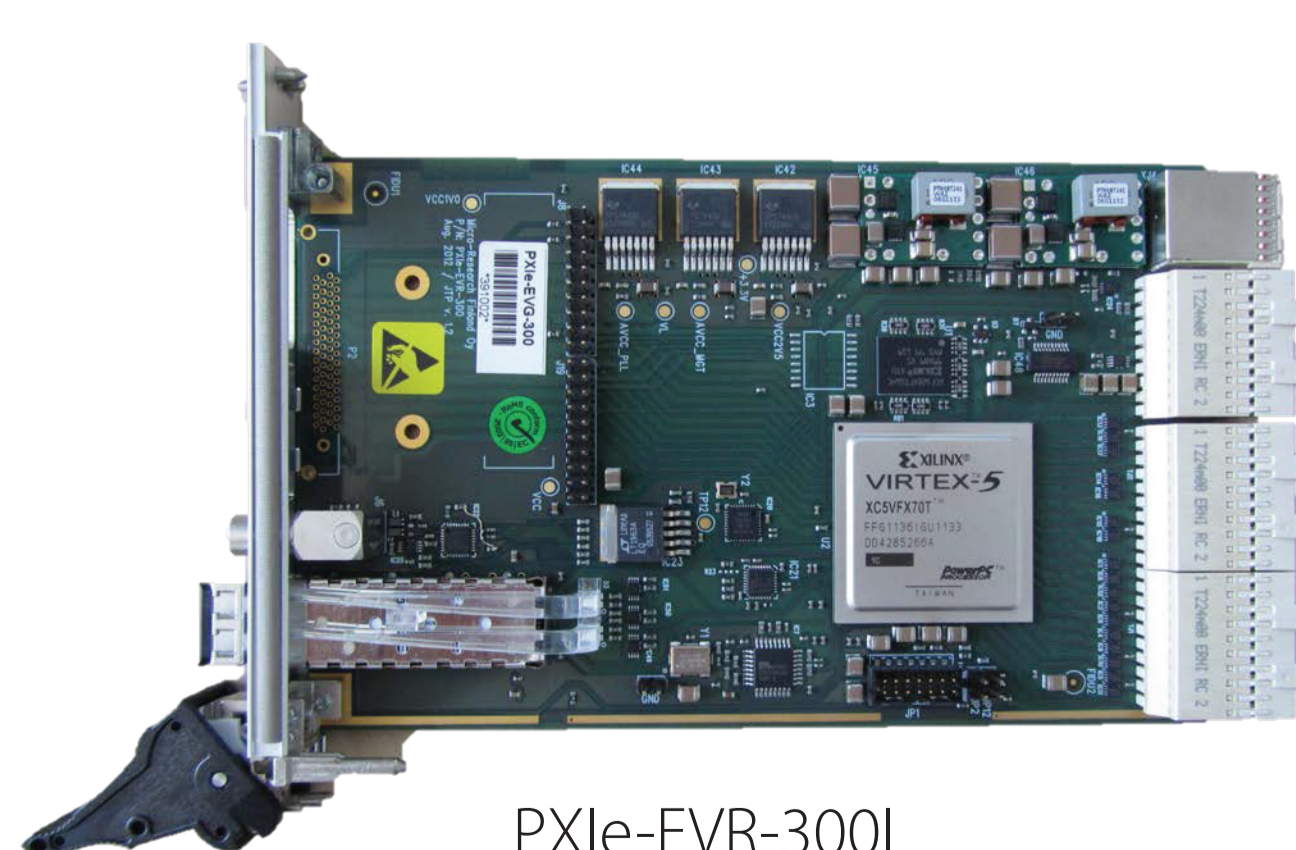
## Hardware Architecture

- Event codes based system
- Deterministic real time data distribution
- Events sent out with event clock rate derived from external RF reference (GPS)
- Event granularity of up to 10 ns (100 MHz)
- All receiver's clocks are phase-locked to the generator clock



## Proven MRF Hardware

- Built on top of Micro-Research Finland (MRF) hardware, ensuring extremely precise synchronization.
- The MRF hardware is powered by CosyLab firmware and software.
- Ensures the best balance between flexibility, usability, robustness and ease of integration with other devices.



## Technical Specifications

- Minimal event resolution: 110ns
- Event time-stamping accuracy: 10ns
- Max number of receivers: unlimited
- Data transmission bound-rate: max 80 Mbit/s

Micro Research Finland equipment list for reference implementation of CTS:

PXIe-EVR-300I + IFB-300 + UNIV-HFBR-1414 allows for export of up to 16 optical triggers per single event receiver.

Product	Description
PXIe-EVG-300	PXI Express Event Generator
PXIe-EVR-300I	PXI Express Event Receiver with VHDCI for IFB-300
IFB-300	I/O Interface Box for PCIe-EVR-300 / PXIe-EVR-300I
UNIV-HFBR-1414	Universal I/O Optical Output Module
IFB-300 cable	Interconnect cable 1 m for I/O Interface Box
UNIV-TTL	Universal I/O module with two TTL level output

## Conclusion

- Highly configurable and easy to use.
- It comes off-the-shelf with dedicated features for PT devices.
- Developed according to industrial development processes (ISO 9001).
- Comes with detailed documentation and expert support.