NVMe FFRAID Recorder
Product Brochure

Based on MLE's NVMe Fast FPGA RAID (FFRAID) this High-Speed NVMe FFRAID Recorder enables loss-less and gapless data recording from multiple data sources to an FPGA-accelerated RAID of NVMe SSDs at speeds of **100/200/400 Gbps**. MLE's NVMe FFRAID implements a channel-based architecture, supports data-in-motion pre- and post-processing and is highly scalable with regards to bandwidth and recording capacity. Multiple systems can further be cascaded via **high-accuracy IEEE time-synchronization** for faster or deeper recording.

Key Features

- Loss-less, gapless recording at **100/200/400 Gbps**
- Up to 16x U.2 bays
- Support **Self-encryption TCG OPAL** SSDs
- Cascading of multiple systems with time-synchronization
- Start-Pause-Stop Data Recording
- Pre-trigger Data Recording in circular buffers
- Adaptable signal front-ends
- Read/write compatible with **Linux Software-RAID**
- 2x 10GBASE-T, 1x COM, 1x VGA, 1x IPMI, 1x USB Type C, 4x USB3 Type A

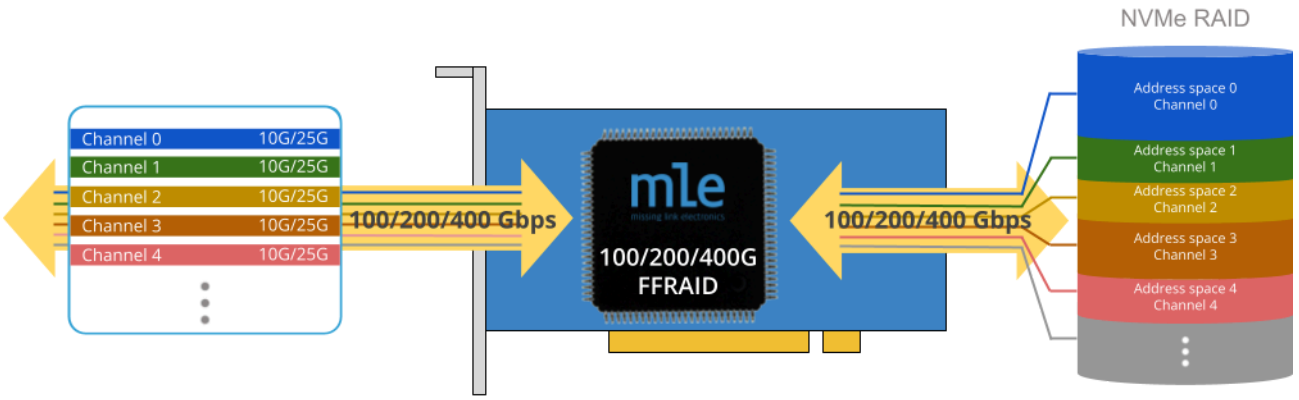
Applications

- Autonomous Vehicle Path Record & Replay
- Automotive / Medical / Industrial Test Equipment
- High-speed Radar / Lidar / Camera Data Acquisition & Storage
- Very Deep Network Packet Capture of Ethernet or IPv4 or TCP/UDP Data

▲ Front View

▲ Rear View

Channel-Based Architecture



MLE's NVMe Fast FPGA RAID System implements a channel-based architecture where each data source/sink can be associated with a dedicated RAID engine and a dedicated storage space. Each channel can have **10/25/50/100 Gbps**, or combinations thereof.

Adaptable signal front-ends support many different I/O standards in a "mix & match" fashion.

This channel-based architecture along with the combination of FPGA NVMe Recording Stack plus a well-tuned PCIe setup, delivers a best-in-class price/performance ratio for high-speed data acquisition, recording and replay. MLE's multi-core NVMe Host Controller Subsystem supports dedicated NVMe queues per SSD in a PCIe Peer-to-Peer communication.

The NVMe FFRAID System also supports high-performance and high-endurance NVMe U.2/U.3 SSDs with self-encryption TCG OPAL security function!

Scalability

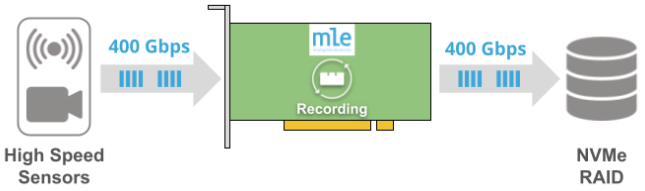
MLE's NVMe FFRAID Recorder supports a wide range of NVMe SSDs and can make use of a range of U.2/U.3 SSD capacities and Drive-Writes-per-Day (DWPD) models. Here a table of possible recording times in minutes:

Storage (TiB) \ Recording Speed (Gbps)	100	150	200	250	300	350	400
5	7.2	4.8	3.6	2.9	2.4	2.0	1.8
10	14.3	9.5	7.2	5.7	4.8	4.1	3.6
15	21.5	14.3	10.7	8.6	7.2	6.1	5.4
20	28.6	19.1	14.3	11.5	9.5	8.2	7.2
25	35.8	23.9	17.9	14.3	11.9	10.2	8.9
30	42.9	28.6	21.5	17.2	14.3	12.3	10.7
35	50.1	33.4	25.1	20.0	16.7	14.3	12.5
40	57.3	38.2	28.6	22.9	19.1	16.4	14.3
45	64.4	42.9	32.2	25.8	21.5	18.4	16.1
50	71.6	47.7	35.8	28.6	23.9	20.5	17.9

Data Recording Use Cases

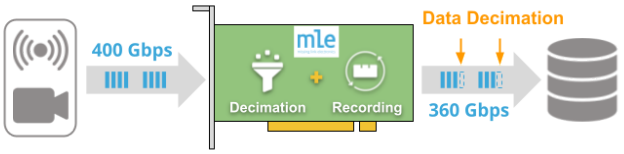
Besides record/replay of raw data we support data-in-motion pre- and post-processing that enables you to add your custom algorithms for indexing and metadata generation, on-the-fly data decimation, or running in “spy-mode” as a transparent data proxy.

Ingress data from the high-speed sensors are transferred and recorded at-speed and as-is onto the NVMe Fast FPGA RAID.



Communication from a high-speed data source can be transported to a data sink while this data is also recorded at-speed.

Unwanted pieces of the ingress data is removed on-the-fly prior to storage. This can, for example, be a selection of certain regions-of-interest (ROI).

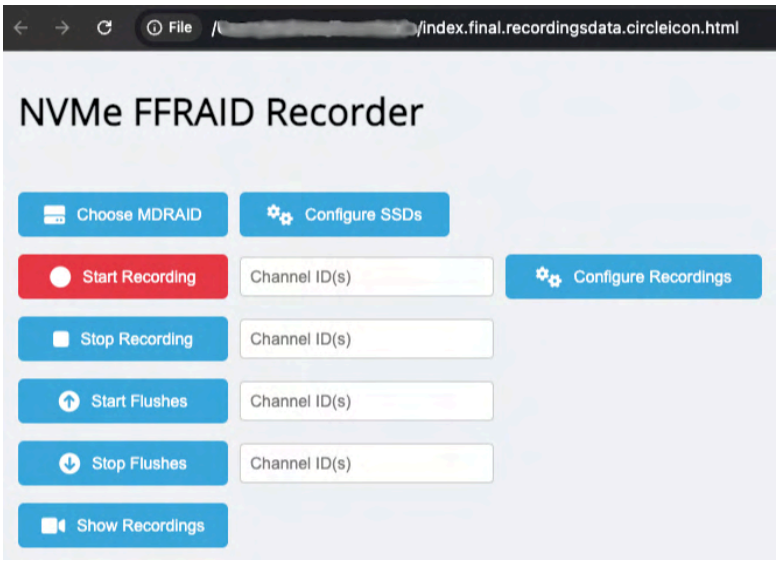


Analyzes ingress data on-the-fly for indexing information for later search, for example. Metadata is then recorded along with the ingress data.

Exemplary Remote User Interface

MLE NVMe FFRAID Recorder supplies Remote Procedure Call (RPC) API Running on a standard open-source Linux OS. This enables users to quickly implement their own look&feel GUI via a webpage or application running on a separate machine, connected to the MLE Recorder via LAN.

To facilitate integration and testing, MLE provides a complete example set of Python and CURL commands for running the Recorder via this RPC API.



Ordering Information

Model Name	Part Number	Description
400G NVMe FFRAID Recorder	NVME-BOX-Rack-400G	PCIe Gen5, 400 Gbps, 2 AMD Alveo V80 High Performance Compute Cards, 3U, 16 U.2 bays supporting self-encryption TCG OPAL SSDs, 22 kg
200G NVMe FFRAID Recorder	NVME-BOX-Rack-200G	PCIe Gen4, 200 Gbps, 2 AMD Alveo U55C High Performance Compute Cards, 3U, 16 U.2 bays supporting self-encryption TCG OPAL SSDs, 22 kg
100G NVMe FFRAID Recorder	NVME-BOX-Rack-100G	PCIe Gen4, 100 Gbps, AMD Alveo U55C High Performance Compute Cards, 3U, 16 U.2 bays supporting self-encryption TCG OPAL SSDs, 20 kg

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Missing Link Electronics (MLE)

We are a Silicon Valley based technology company with offices in Germany. We are partner to leading electronic device and solution providers and have been enabling key innovators in the automotive, defense, industrial, medical, test & measurement markets with FPGA-based subsystems and systems.

Our mission is to develop, support and market Domain-Specific Architectures for High-Performance Compute and Embedded Systems by accelerating and offloading open-source (Linux) software with FPGA.

Our expertise is “packets” which means Data-in-Motion systems with high-speed I/O connectivity and acceleration of data communication protocols as they are, for example, used in networking, storage and audio/video processing. We have been opening up FPGA technology for high-speed analog applications, and have been driving the integration and optimization of Open Source Linux and Android software stacks on modern heterogeneous processing architectures. This is complemented by expertise in Functional Safety and Security / Trusted Execution (OP-TEE).