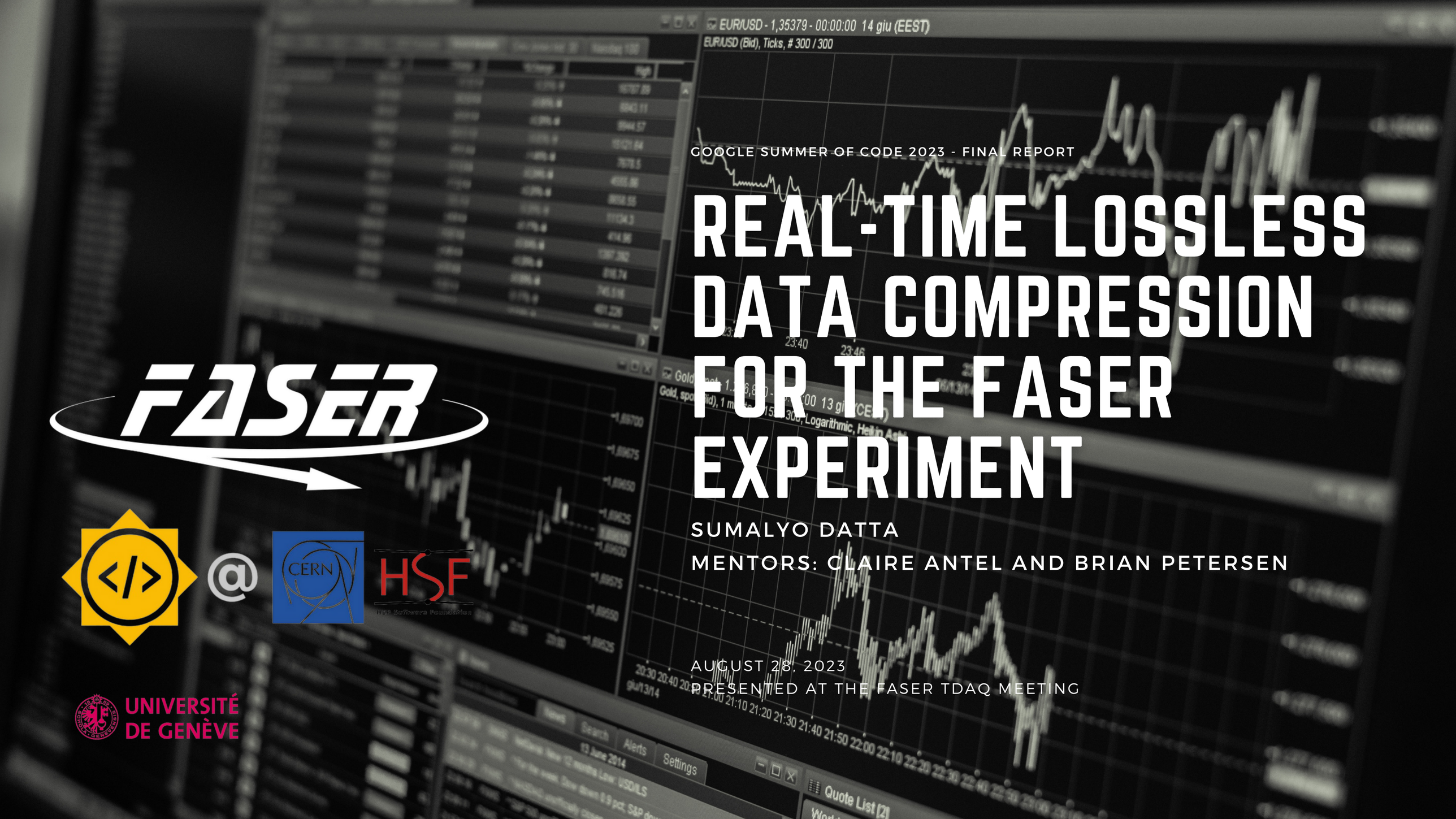


GOOGLE SUMMER OF CODE 2023 - FINAL REPORT

REAL-TIME LOSSLESS DATA COMPRESSION FOR THE FASER EXPERIMENT

SUMALYO DATTA

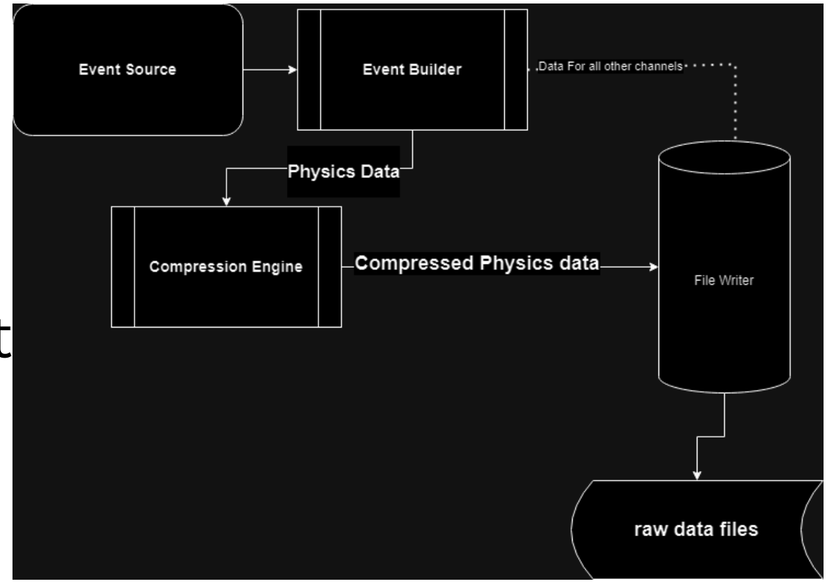
MENTORS: CLAIRE ANTEL AND BRIAN PETERSEN

AUGUST 28, 2023

PRESENTED AT THE FASER TDAQ MEETING

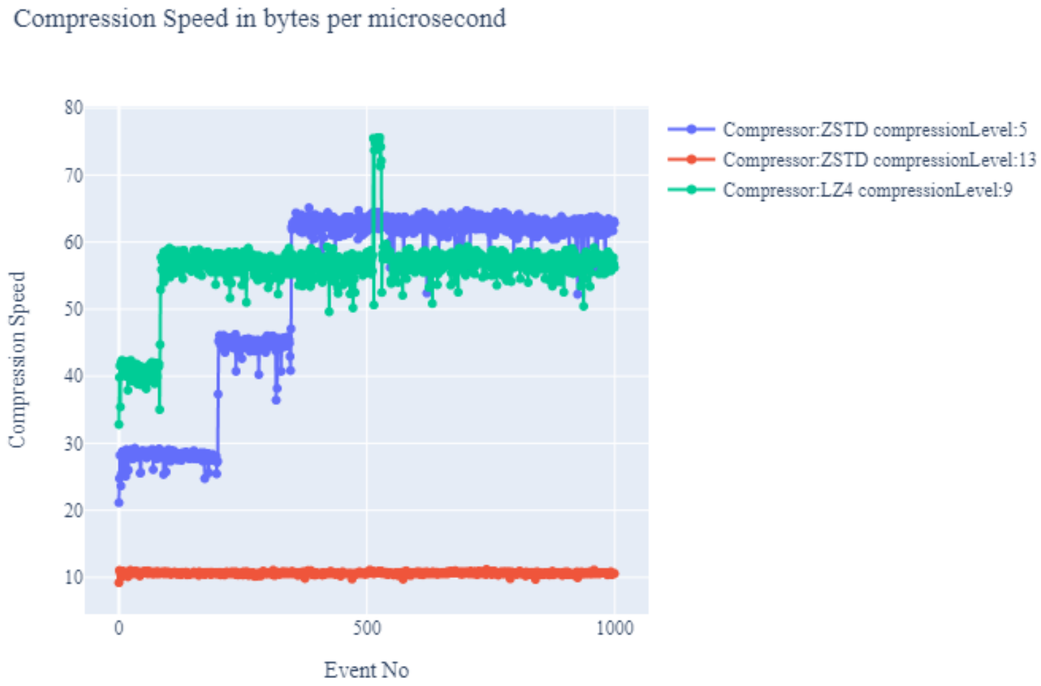
PROJECT OVERVIEW

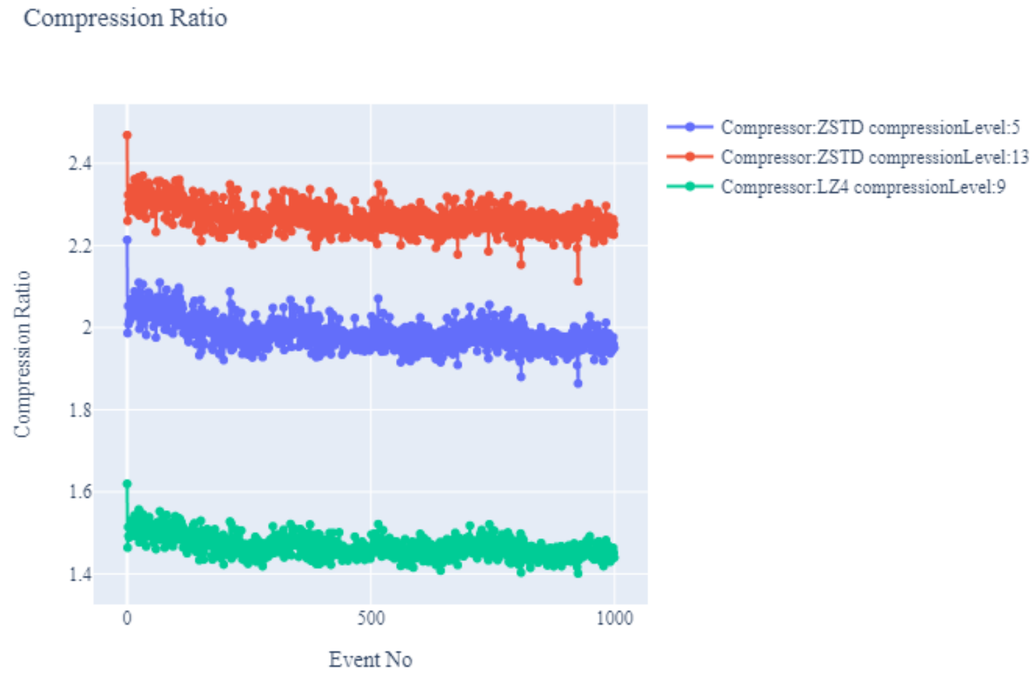
- The FASER, or the Forward Search Experiment, is a small, low-budget LHC experiment designed to search for light and extremely weakly interacting particles.
- The Data Acquisition (DAQ) software records events at a rate of about 1.5kHz.
- The experiment uses DAQling, a modular, lightweight C++ framework, to design the DAQ software.
- It aims to reduce costs by reducing its data storage demands, which have already exceeded initial estimates.
- This project explored various compression libraries and implemented a **compression engine module** that compresses physics events in real time without introducing DAQ bottlenecks.



DAQ Software with the Compression Module

COMPRESSION LIBRARIES





- **ZSTD Compressor:** High Compression, moderately fast, optimized
- **Zlib Compressor:** Fairly good compression, slow, not optimized
- **LZ4 Compression:** Poor Compression, very fast, not optimized

It was observed that a high compression ratio often came at the cost of compression speed. The results were recorded and analyzed to find the most optimal configuration.

HIGH RATE EVENT TESTING

Metrics were published on the Grafan dashboard during a run of the actual complete experiment running at event rates as high as 4kHz. The Compressor performs quite well.

THANK YOU!