

# Accelerating ROOT compression with Intel ISA-L Library

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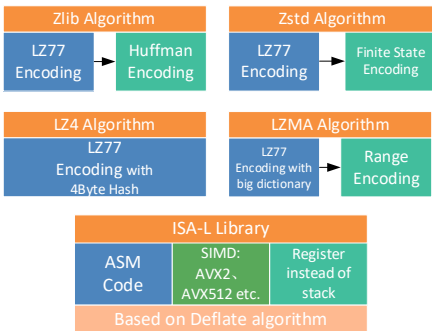
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## Introduction

- To save storage space, data in ROOT can be **compressed before being stored**.
- ROOT currently supports **multiple data compression algorithms** including Zlib, LZMA, LZ4, Zstd, etc.
- The Intel Intelligent Storage Acceleration Library (ISA-L) provides tools to accelerate the Deflate compression algorithm.
- This work aims to accelerate ROOT compression with ISA-L library.

## Background

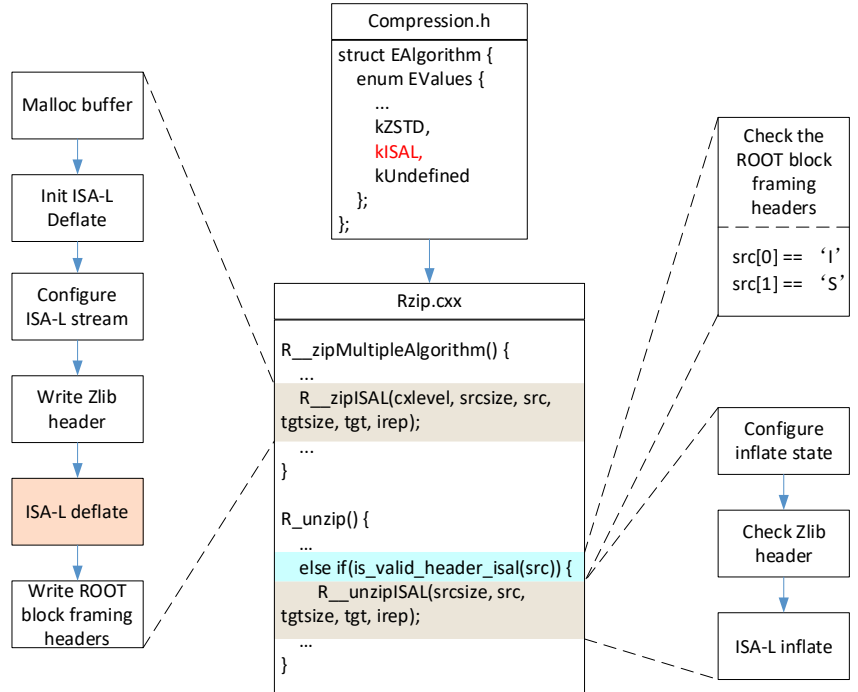


Both the Zlib algorithm and the ISA-L compression acceleration library are based on the **Deflate** algorithm. Zlib simply encapsulates the final file format. ISA-L accelerates the Deflate algorithm from the following aspects:

- Use **assembly language** to write algorithm code.
- Use the **SIMD instruction** set to speed up the calculation process.
- Use **registers** instead of stacks.

## Implementation

Encapsulate the ISA-L stream interface according to the inherent interface in ROOT.



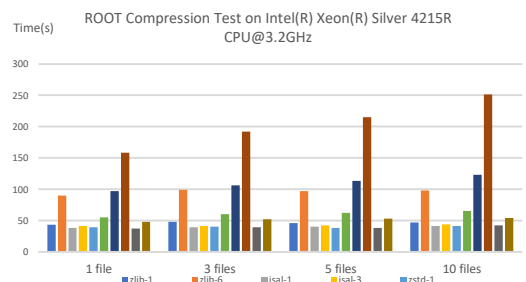
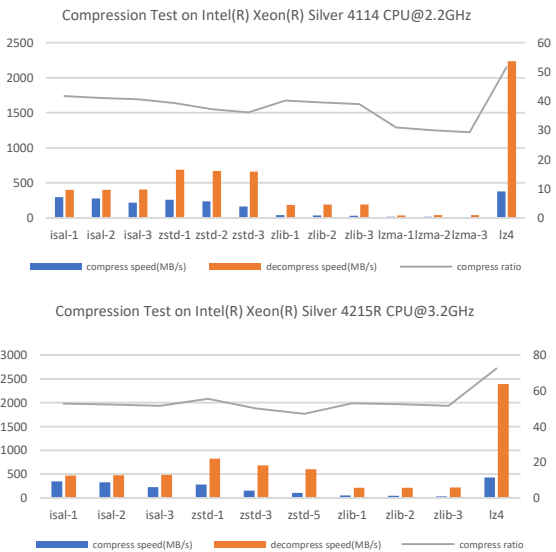
How to call the ISA-L compression algorithm in ROOT:

```

User code

TBranch * branch = Tree -> GetBranch( BranchName() );
int cLevel = branch -> GetCompressionLevel();
// int cLevel = 1; // The range can be set to 0-3
branch -> SetCompressionAlgorithm( ROOT::RCompressionSetting::EAlgorithm::kISAL );
branch -> SetCompressionLevel( cLevel);
    
```

## Results



Evaluate total time when an ROOT application invokes different compression algorithms. Here we take LHAASO-WFCTA decode as an example.

## Conclusion

- The compression time of the ISA-L is about five times of that of the Zlib algorithm, but the results compared to other algorithms vary from machine to machine.
- The compression time performance of the ISA-L library is similar to or better than the Zstd algorithm, but the decompression time performance is worse than Zstd.
- Newer CPUs tend to support more advanced instruction sets, so the performance of the ISA-L library tends to be better.

The performance comparison of different compression algorithms, independent of ROOT, using modified lzbench tool. (<https://github.com/zero1248/lzbench-isal>)