Video Transcoding + Sim Theory's Thunder SDK: A Client Case Study

Introduction

Sim Theory was engaged by Encant to help design and engineer a novel video format with unique storage and performance characteristics compared to other codecs on the market.

A new transcoding algorithm was required to convert pre-existing video clips into this sparser and more extensible format - on average 60% sparser than traditional video - as well as a custom decoder for proof-of-concept playback.

Given the format's computationally-intense nature, custom hardware was deemed a likely requirement for bringing any encoding or decoding products to market. This was a serious hurdle for a startup like Encant, as the design, optimization, and production of custom ASIC hardware is commonly understood to run into the tens[1] or hundreds[2] of millions of dollars.

Instead, Sim Theory engineers coded a software-only solution taking advantage of the unique performance enhancements of the Thunder SDK. Once fully integrated, post-development testing demonstrated the compute boost necessary to comfortably run Encant's video tech on commonly available desktop, laptop, and cloud hardware.

"Sim Theory's Thunder SDK allows us to push the boundaries of software computation without the need for custom hardware," said Scott Dacko, Encant's Founder and CEO. "It fills a critical need for our business, enabling us to scale faster and wider than any other solution on the market."

Sim Theory and Encant are working jointly on the next phase of this project with announcements coming later in 2025.

Goal

This pilot program with Encant used Sim Theory's Thunder SDK to encode video in a performant manner from a variety of widely-available codecs into Encant's novel format, and then decode it for playback on commonly-available desktops, laptops, and AWS configurations.

[1] https://anysilicon.com/custom-asic-the-ultimate-guide/
[2] https://netint.com/asics-for-video-encoding-optimize-efficiency-and-cost/

The Products

Two proof-of-concept executables were developed, an encoder and decoder, both utilizing the Thunder SDK.

The encoder is a command line application leveraging FFmpeg to decode source video to raw frames which are then re-encoded in Encant's new sparse data video format. It leverages the Thunder SDK's scheduling technology, concurrent containers, algorithms, and the core SIMD and vectorized math libraries. It was built to run on Windows, and Linux x64 and aarch64 CPU architectures.

The decoder was built to replay native video from Encant's new format and supports the same architectures.

Testing

Video encoding was tested by running in the following environments:

- ➔ Desktops containing between 2 and 64 AMD cores running Windows x64
- ➔ Laptops containing between 2 and 16 Intel cores running Windows x64
- ➔ AWS EC2 Instance c5a.4xlarge with a Windows environment
- ➔ AWS EC2 Instance t4g.xlarge with a Linux environment

Performance

Initial development called for implementing the algorithm with the Thunder SDK using a single thread. Limiting computation in this way allowed the engineers to focus on proving out the algorithm's base ability to render video in a novel manner while generating sufficient hard data to demonstrate both improvements in sparsity and the technique's ability to preserve and reconstruct pixel-accurate video.

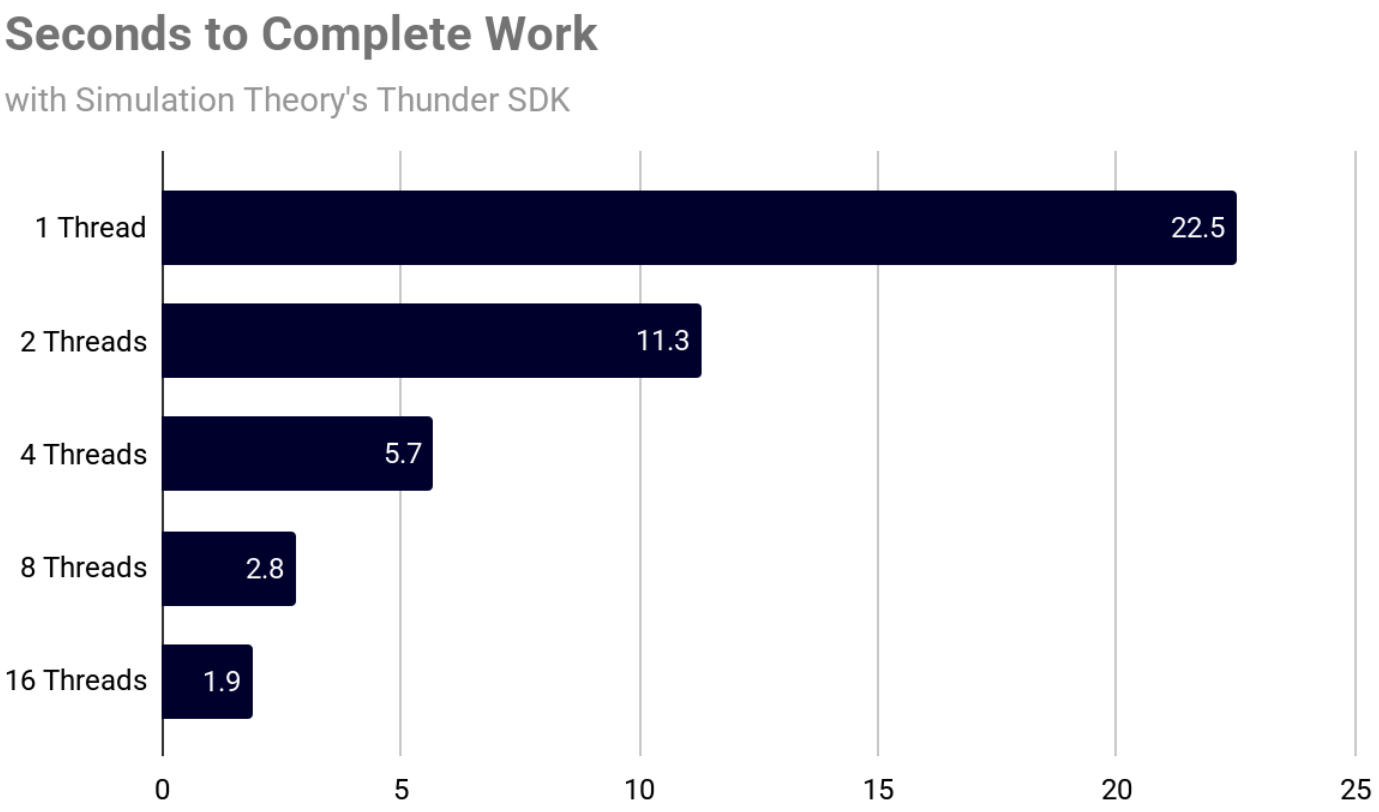
Analysis of this first phase demonstrated that the algorithm, when implemented with Sim Theory's Thunder SDK, could encode and decode quickly enough on commonly-available desktop and laptop CPUs that custom hardware wouldn't be required in the future.

Additional AWS testing proved that common cloud hardware configurations were performant enough to run the system, validating the algorithm's potential for live video streaming applications and cloud storage cost reduction.

Once implementation of the algorithm was achieved, Sim Theory used the Thunder SDK to accelerate the encoder, processing frame data in parallel, rather than serially. Data was generated, de-duplicated, and optimized to improve sparseness. Superior parallel processing allowed the encoder to run on all available threads on commonly-available hardware.

Parallelization testing was completed on an AWS EC2 c5a.4xlarge Windows instance. This work took 22.5 seconds to complete on a single thread. Sim Theory was able to reduce completion time to 1.9 seconds by scaling processing across 16 threads - a reduction of 91.5%.

The on-demand hourly rate of the AWS instance used for testing was $1.352[3]. The cost for processing the work using a single thread was $0.51. Using the Thunder SDK to enable processing on 16 cores, the cost dropped to $0.04.



[3] https://aws.amazon.com/ec2/pricing/on-demand/

Ongoing Collaboration

Sim Theory and Encant are currently developing a commercial product based on Encant's new approach to video transcoding, one that promises near-term reductions in data rates and file sizes and long-term advances in video functionality.

"Sim Theory is helping take our concept from R&D to market, faster and cheaper thanks to their Thunder SDK," said Dacko. "We are looking past what video is today, to what it can be, and consider their team and tech an essential part of our development pipeline."

Author: Randy Culley, CTO
sales@simtheoryinc.com
simtheoryinc.com
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