

ZipAccel-C

GZIP/ZLIB/Deflate Data Compression Core



ZipAccel-C is a custom hardware implementation of a lossless data compression engine that complies with the Deflate, GZIP, and ZLIB compression standards.

The core receives uncompressed input files and produces compressed files. No post processing of the compressed files is required, as the core encapsulates the compressed data payload with the proper headers and footers. Input files can be segmented, and segments from different files can be interleaved at the core's input.

The core's flexible architecture enables fine-tuning of its compression efficiency, throughput, and latency to match the requirements of the end application. Throughput can scale to tens of Gbps at the expense of silicon resources, and latency can be as small as a few tens of clock cycles.

ZipAccel-C offers compression efficiency practically equivalent to today's popular deflate-based software applications. Analyzing processing speed versus compression efficiency to achieve the best tradeoff for a specific system is facilitated by the included software model, and by support from our team of data compression experts.

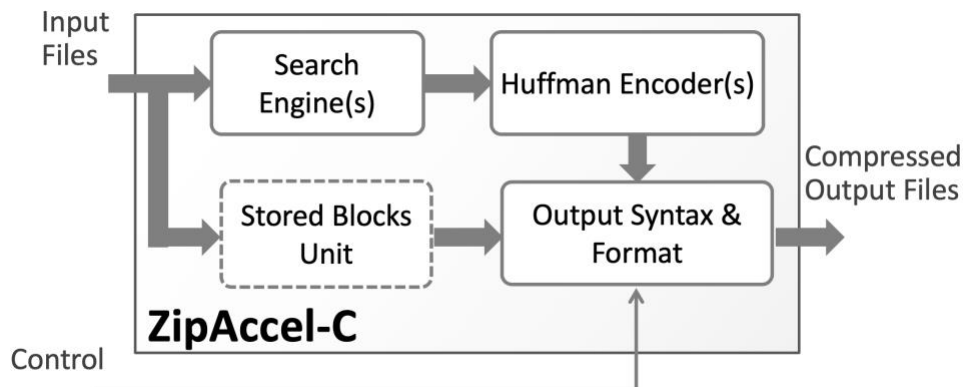
ZipAccel-C has been designed for ease of use and integration. It operates on a standalone basis, off-loading the host CPU from the demanding task of data compression, and optionally from the task of encrypting the compressed stream. Streaming AXI-Stream or native FIFO-like data interfaces ease SoC integration.

Technology mapping is straightforward, as the design is scan-ready, LINT-clean, microcode-free, and uses easily replaceable, generic memory models. Memory blocks can optionally support Error Correction Codes (ECC) to simplify achieving of Enterprise-Class reliability requirements. Furthermore, input file segmentation can limit the inter-file latency and helps users achieve Quality of Service (QoS) objectives.

Applications

The ZipAccel-C core is ideal for increasing the bandwidth of optical, wired or wireless data communication links, and for increasing the capacity of data storage in a wide range of devices such as networking interface/routing/storage equipment, data servers, or SSD drives. The core can also help reduce the power consumption and bandwidth of centralized memories (e.g. DDR) or interfaces (e.g. Ethernet, Wi-Fi) in a wide range of SoC designs.

Block Diagram



FEATURES

Compression Standards

- Deflate (RFC-1951)
- ZLIB (RFC-1950)
- GZIP (RFC-1952)

Deflate Features

- LZ77 with configurable block and search window size
- Static and dynamic Huffman
- Optional stored deflate blocks
- Dynamic mode selection

Flexible Architecture

- Fine-tune throughput, compression efficiency, and latency to match application requirements
 - Scalable throughput limited only by available silicon resources
 - Compression efficiency can be on par with Unix/Linux max compression option (gzip -9)
 - Silicon requirements start from less than 10k slices
 - Under 40 clock cycles for static Huffman
- Configuration options (partial list):
 - Search engine and Huffman encoder architecture
 - History search window size (up to 32kb)
 - Deflate block size
 - Stored blocks support
 - Parallel processing level

Easy to Use and Integrate

- Processor-free, standalone operation
- Streaming AXI-Stream or native FIFO-like data interfaces
- Large file segmentation enables meeting QoS objectives
- Microcode-free, LINT-clean, scan-ready design
- Optional ECC memories
- Optionally integrated with DMA, encryption or other cores from CAST

Implementation Results

ZipAccel-C reference designs have been evaluated in a variety of technologies. ZipAccel-C performance can scale by instantiating more search engines and/or Huffman encoders. Furthermore, other design options, such as the search area window, affect the silicon resources utilization.

The core can be mapped on any Lattice FPGA provided sufficient silicon resources are available. The following are sample implementation results for a small subset of the possible configuration options of the core on a CertusPro-NX and an Avant-E device, and do not represent the smallest possible area requirements nor the highest possible clock frequency.

Configuration	Freq (MHz)	Logic Resources	Memory Resources
1 Systolic Search Engine, 1 Static Huffman Encoder, 512B History Window	155	16,694 Slices	15 EBR
1 Systolic Search Engine, 1 Static Huffman Encoder, 2kB History Window	140	35,941 Slices	16 EBR
1 Hash Search Engine, 1 Dynamic Huffman Encoder, 8kB History Window	110	27,943 Slices	65 EBR
1 Hash Search Engine, 1 Dynamic Huffman Encoder, 32kB History Window	100	28,022 Slices	99 EBR

Table 1: Sample implementation results for CertusPro-NX (LFCPNX-100, performance grade 9)

Configuration	Freq (MHz)	Logic Resources	Memory Resources
1 Systolic Search Engine, 1 Static Huffman Encoder, 512B History Window	180	7,734 Slices	8 EBR
1 Systolic Search Engine, 1 Static Huffman Encoder, 2kB History Window	175	23,338 Slices	8 EBR
1 Hash Search Engine, 1 Dynamic Huffman Encoder, 8kB History Window	145	19,271 Slices	48 EBR
1 Hash Search Engine, 1 Dynamic Huffman Encoder, 32kB History Window	140	19,253 Slices	50 EBR

Table 2: Sample implementation results for Avant-E (LAV-AT-500E, performance grade 1)

Please contact CAST Sales to get characterization data for your target application and technology.

Verification

The core has been verified through extensive synthesis, place and route, and simulation runs. It has also been embedded in several commercially-shipping products and is proven in both ASIC and FPGA technologies.

Deliverables

The core is available in synthesizable HDL (System Verilog) or targeted FPGA netlist forms and includes everything required for successful implementation. Its deliverables include:

- Sophisticated Test Environment.
- Simulation scripts, test vectors and expected results
- Synthesis script
- Comprehensive user documentation

Support

The core as delivered is warranted against defects for ninety days from purchase. Thirty days of phone and email technical support are included, starting with the first interaction.

Additional maintenance and support options are available.

Related Cores

- ZipAccel-D: GZIP/ZLIB/Deflate Data Decompression Core
- AXI4-SGMDA: AXI4 to/from AXI4-Stream Scatter Gather DMA
- MM2ST: Memory Mapped to Stream Interface Bridge