QOID

QOI Lossless Image Compression Decoder

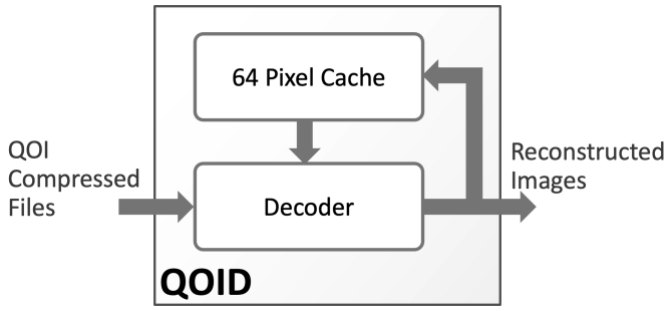
The QOID Core is a decoder that implements a highly efficient, low-power, lossless image decompression engine compliant with the Quite OK Image format (QOI) specification, version 1.0.

The QOI algorithm compresses RGB or RGBA images with 8 bits per color without any loss. It has a compression efficiency close to that of the PNG compression, at a fraction of the computational complexity.

Capitalizing on the simplicity of the QOI algorithm, the QOID decoder core can decompress images at a very high speed and with minimal silicon resources. The core occupies less than 250 ALMs and can decode one pixel per clock cycle. A single core instance can decompress images at rates sufficient for UHD 4k50 on Agilex™ devices on 4k30 on Arria10 devices.

The core is designed for ease of use and integration and adheres to coding and verification best practices. It requires no assistance from a host processor and uses simple handshake interfaces for input and output data. Technology mapping, timing closure, and scan insertion are trouble-free, as the core contains no multi-cycle or false paths and uses only rising-edge-triggered D-type flip-flops, no tri-states, and a single-clock/reset domain. Its reliability and low risk have been proven through rigorous verification and FPGA validation.

Block Diagram



FEATURES

QOI Image Format

- Lossless compression
- Supports RGB and RGBA, 8-bit per color images
- Compression performance similar to that of PNG with a fraction of the computational complexity

QOID IP Core

- QOI decompression with a compact and high-throughput hardware decoder
- Receives raw header-less QOI files
  - Optional QOI header processing
- Supports RGB images
  - RGBA support can be added on request

High-Throughput

- 1 pixel per clock-cycle throughput
- A single core is UHD/4k-capable

Compact and Low-Power

- Approximately less than 250 ALMs

Deliverables

- VHDL or Verilog RTL source code or targeted FPGA netlist
  - Verilog can be made available on request
- C-model for test vectors generation
- Integration Test-Bench
- Simulation & synthesis scripts
- User documentation

Applications

Numerous applications can benefit from the tiny silicon footprint and ultra-low-power consumption of the QOI compression and decompression cores CAST offers. Typical uses include frame buffer compression for video processing SoCs; graphic elements or display buffer compression; and image storage and transmission for medical, aerospace, and other systems.

Sample Implementation Results

The QOID is a digital core and can be mapped to any Intel® FPGA device (provided sufficient resources are available). The following are sample implementation results. These sample results do not represent the minimum area or the fastest clock speed for the QOID core. Please contact CAST to get accurate characterization for your target device and throughput requirements.

Target Family/Device	Logic Resources	Memory Resources	Freq. (MHz) / Mpixels/s
AGILEX™ Speed grade -2	219 ALMs	1 RAMB	450
Arria® 10 GX Speed grade -1	158 ALMs	1 RAMB	300