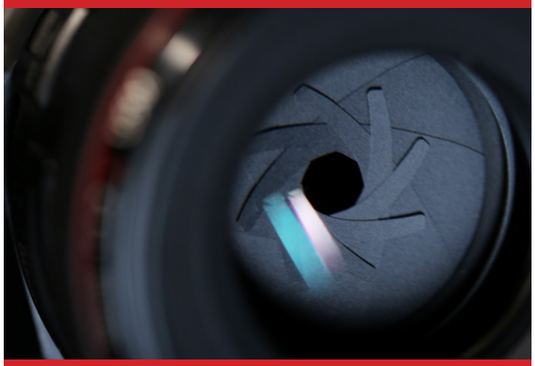
BROADCAST
VIDEO



BarcoSilex

Enabling Video Equipment to Compress and Transport High-Quality Content

Jean-Marie Cloquet, Video Product Manager, Barco-Silex

As HD and Ultra-HD video formats become ubiquitous, there is an enormous amount of additional video bits that need to be compressed and transported. While regional markets adopt 4K and 8K video, bit processing, compression and transit will grow exponentially in the coming years in studios, networks, end-users homes and mobile devices. Eventually, all equipment, from cameras to post production tools, from distribution routers to displays will require the ability to compress or decompress video, supporting various standards, depending on the use and situation.

Barco Silex, a Xilinx Alliance Program Member, is an expert in compression technology and one of the world's premier providers of IP blocks that implement video compression. Xilinx FPGAs have proven to be effective platforms to build integrated video solutions. In an effort to leverage their respective technologies in the video market, both Xilinx and Barco Silex collaborate to offer equipment OEMs a platform of validated hardware blocks, reference designs and system integration services.

Barco Silex's IP cores for FPGAs include a full range of compression schemes, matching various requirements including latency, compression ratio and cost within the video industry. In certain situations such as between links, a provider may only need lightweight compression, which is a more cost-effective solution, that allows a 12 Gbit/s UHD video stream to be transported over a 10 Gbit/s link. In other situations, more versatile compression may be needed, where video is transported between the nodes of a contribution network.

In addition to these hardware blocks, Barco Silex also offers integration services and reference designs. An example is Barco Silex's Emmy® awarded video-over-IP reference design. This design links video interfaces to IP networks, allowing compressed or uncompressed video streams to be transported over today's prevalent network technology.

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JPEG 2000 – Offering the Fastest, Most Versatile IP for High-quality Compression

JPEG 2000 is the codec for heavy-duty video compression with superior quality. It has many attributes that make it best-suited for video compression and transport in contributing networks. It is an intra-frame codec, meaning each frame in the video stream is compressed individually as a still frame and provides powerful, visually lossless compression. This results in low latency, but also provides easy per-frame post-processing and editing. Since 2004, it has been the de-facto standard format for image compression in digital cinema (through the Hollywood-backed DCI specification).

Barco Silex offers a range of high quality solutions for JPEG 2000 applications. Our portfolio covers IP cores, reference designs and acceleration boards. The IP cores can encode or decode JPEG 2000 images and video with high quality, speed and provides a compact footprint that is unrivaled. Barco Silex's solutions have been successful integration by market leaders of digital cinema, cameras, production, editing, contribution, storage, airborne surveillance, video and traffic surveillance.

Barco Silex's video engineers have implemented our IP to address future scalability, IP trends and evolutions in video equipment including:

- High resolution images: Up to HD and UHDTV (8K), DCI 2K and 4K
- Flexible multi-channel support (ideal for stereoscopic 3D)
- Sub-frame latency without tiling (maintaining best image quality)
- High throughput: Up to 1+ Gbit/s
- High speed applications (beyond real-time)
- Lower resolution or quality with lower resource usage
- Footprint scalability according to requirements

Both the encoder and decoder modules are optimized for speed and able to deal with demanding DCI and HD processing requirements. They can be used in a single-chip FPGA solution for all 2K@24 fps, 2K@48fps, 2K3D@24fps, 4K@24fps, 4K3D@24fps, 720p30/60, 1080i and 1080p30/60 resolutions.

Video-over-IP – Enabling Interoperable Video Transport

Equipment suppliers have been integrating JPEG 2000 encoders and decoders in their video equipment for some time. However, for transport between locations, they still have a choice between a wide range of implementation options, with some opting to use proprietary protocols. One problem video service providers encounter is utilizing products of one or a just a few vendors, instead of incorporating infrastructure that best matches their requirements.

The solution to this problem is a new standard that allows JPEG 2000 to be transported over IP networks. Barco Silex is a member of the Video Services Forum that published this solution, and Barco Silex played a prominent role in its conception. Rather than defining a whole new scheme for video compression and encapsulation, the new VSF-TR-01 defines a common operating point within existing standards (SMPTE 2022). This permits, for the first time, true JPEG 2000 interoperability.

Barco Silex's video specialists are experts regarding this JPEG 2000 solution, and they have been among the first to include it in full-fledged designs. As a system integrator, Barco Silex implemented VSF-TR-01, matching their own JPEG 2000 cores to Xilinx's tried and tested hardware blocks for video transport (SMPTE 2022, SMPTE SDI, and Ethernet MACs). The resulting reference design is implemented on two platforms, one using the Zynq-7000 SoC and the other the Kintex7 FPGA. The hardware blocks can be integrated in a full range of Xilinx products, covering the complete spectrum of OEM system requirements, from low-cost, high-volume applications to the most demanding high-performance applications.

At NAB 2015, Barco Silex will demonstrate a design that also supports 4K and UHD signals. Using the four input channels of the reference design in quad-SDI mode (4K carried over 4 SDI cables), it can take a 4K input signal and send it over an IP network. At NAB, Barco Silex will also show an ultralow-latency solution for J2K-over-IP.

VC-2 – Lightweight Compression for High-definition Video Formats

There is strong demand in the video industry for cost-efficient, lightweight compression, to transport high-definition video formats over legacy equipment with lower bandwidth. The VC-2 LD (Low Delay) codec, which is now implemented by Barco Silex as a hardware IP core was designed and built into a cost-effective hardware solution that doesn't require excessive resources. The VC-2 LD codec hardware core is a solution that can be integrated in existing designs and low-end Xilinx FPGAs.

With VC-2 LD, full HD video can be transmitted over 3 Gbit/s SDI links, and the bit rate can be halved to make it better suited for 1.5 Gbit/s SDI links. Cables for 1.5 Gbit/s SDI links are more common and less expensive and they support longer cable runs needed for outdoor broadcasting.

The emerging UHD video poses a particular challenge for existing interconnect links, requiring up to 12 Gbit/s. With VC-2 compression, UHD video bandwidth can be reduced by a factor of 4x, enabling use of less expensive cable infrastructure. VC-2 LD compression can be even more effective for higher 120Hz frame rates and 12 bit 4:4:4 signals. It has been officially accepted as an SMPTE standard, it does not originate from a single vendor, and it is license/cost free.

MPEG-2 – Meeting the Most Stringent Requirements

Although more recent standards such as JPEG 2000, H.264, and H.265 are widely adopted, MPEG-2 exists in a large number of legacy systems. Barco Silex MPEG-2 cores provide legacy systems with backward compatibility, while meeting today's state-of-the-art requirements in terms of resolution, multi-channel performance, resource footprint and target technology. Barco Silex cores are optimized for any of the following requirements:

- High resolution images: up to HD 1080i and 1080p, DCI 2K and 4K
- Flexible multi-channel support
- Frame rate up to 120fps
- Optimal resource usage
- Compliant with MPEG-2 TS (Transport Streams)

JPEG – Bridge to the World of Computing

With Barco Silex's JPEG hardware cores, video hardware can be equipped with fast, state-of-the-art JPEG functionality. Barco Silex's JPEG hardware cores encode or decode images that can be exchanged with every modern computer system.

Key Benefits:

- 100% compliant to baseline ISO/IEC 10918-1 JPEG standard
- High image quality
- Optimized engine to sustain processing of 1 pixel/clock cycle
- Flexible single-pass rate control

Quality IP Blocks for FPGA and Integration Services – The Fast Track to Building Your Equipment

Barco Silex designs its IP blocks with easy integration with testing in mind. All the blocks are straightforward to integrate and include extensive testing routines, which allows the application to be tested live, instead of testing as a simulation. This is also reflected in Barco Silex's flexible business models that include single or multi-project licenses, comprehensive integration support, facilitated retargeting/upgrades, and maintenance.

Barco Silex handles all FPGA design steps, from the conception to the delivery of an FPGA netlist and PCB/board manufacturing. The Barco Silex partnership with Xilinx provides customers the latest FPGA technologies for the best price.

Pre-study and Specification

- Specification definition in close collaboration with customer
- FPGA selection
- Cost evaluation
- IP selection

Design and Verification

- Architecture definition - modular, generic, scalable and portable
- RTL coding (VHDL, Verilog)
- Linting verification according to set of coding rules
- Extensive simulations at module and top level
- Advanced co-simulation flow with test scenarios in C or python that can be applied in simulation and during on-board testing.
- Non-regression testing

Implementation

- Automated synthesis and mapping flow
- Constraints definition and timing closure

On-board Validation

- FPGA debugging using probing, debug modules
- Advanced verification flow using same test scenarios as in simulation with communication through JTAG, PCIe, Ethernet
- Automated flow

Corporate Headquarters

Xilinx, Inc.
2100 Logic Drive
San Jose, CA 95124
USA
Tel: 408-559-7778
www.xilinx.com

Europe

Xilinx Europe
One Logic Drive
Citywest Business Campus
Saggart, County Dublin
Ireland
Tel: +353-1-464-0311
www.xilinx.com

Japan

Xilinx K.K.
Art Village Osaki Central Tower 4F
1-2-2 Osaki, Shinagawa-ku
Tokyo 141-0032 Japan
Tel: +81-3-6744-7777
japan.xilinx.com

Asia Pacific Pte. Ltd.

Xilinx, Asia Pacific
5 Changi Business Park
Singapore 486040
Tel: +65-6407-3000
www.xilinx.com

India

Meenakshi Tech Park
Block A, B, C, 8th & 13th floors,
Meenakshi Tech Park, Survey No. 39
Gachibowli(V), Seri Lingampally (M),
Hyderabad -500 084
Tel: +91-40-6721-4000
www.xilinx.com

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To accelerate the FPGA development and time-to-market, we take advantage of modules from our “internal re-use database” as well as the best available IP cores from Barco Silex or its partners. Those include PCIe DMA, DDR memory controller, video module toolbox, high-speed serial interfaces, network interfaces, and a lot more. Barco Silex also has long-term experience with ARM processors for ASIC and SoC design. In combination with our expertise in embedded software, Barco Silex builds systems based on Xilinx FPGA and SoC devices.

For More Information

Barco Silex has its headquarters in Louvain-La-Neuve (Belgium), and offices in Ghent and Aix-en-Provence. Its 50 experts build IP blocks and offer FPGA and ASIC services, specializing in video and encryption. Barco Silex is a 100% daughter of Barco, the global leader in digital cinema and display technology.

Barco Silex SA
Rue du Bosquet, 7
1348 Louvain-la-Neuve
Belgium

Email : barco-silex@barco.com
Website : www.barco-silex.com
Twitter : https://twitter.com/barcosilex

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