SYSTEM

Vision Systems

CompactPCI® Serial for High Speed Camera Interfaces 5Gbps - 20Gbps

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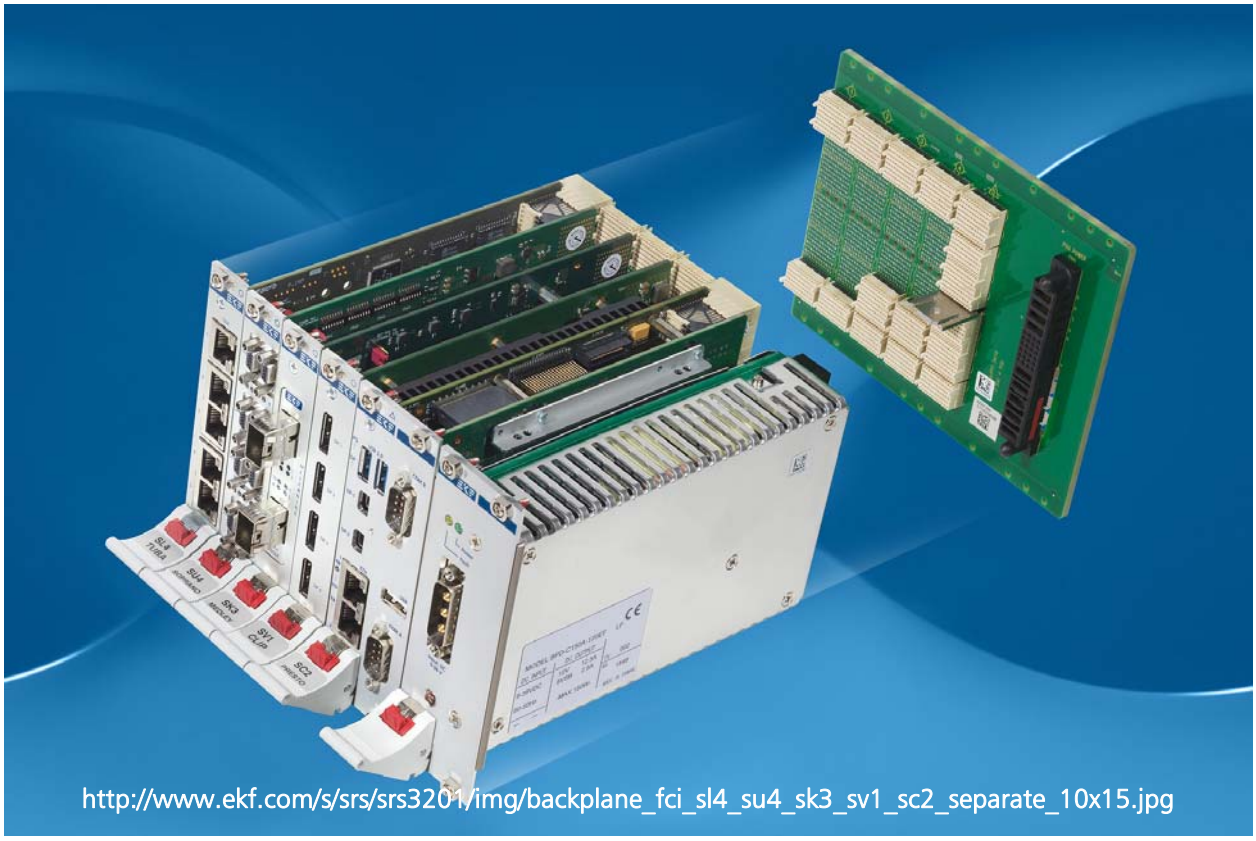
Basics

CompactPCI® Serial is a worldwide common standard for modular industrial computer systems. An increasingly important application is image capturing and vision processing, for automated optical inspection systems as well as augmented reality and autonomous driving.

CompactPCI® Serial is based on plug-in Eurocards for rugged 19-inch systems with passive backplanes. Suitable interface boards are available for nearly all types of high performance industrial cameras, and also graphics controllers for video output.



http://www.ekf.com/s/srs/srs3201/img/backplane_fci_sl4_su4_sk3_sv1_sc2_separate_10x15.jpg

On the following pages, EKF presents several popular interface solutions for machine vision systems, suitable for demanding data rates.

From 5Gbps off the engineer may chose between USB 3.0, Camera Link, 10Gb Ethernet, and PCI Express®.

USB 3.0 (5Gbps)

USB 3.0 is a popular camera interface choice. With the data transfer rate of 5Gbps being fairly sufficient for medium sized resolution images, the integrated power supply might be of interest for a lot of different applications. However, often several USB ports share the same controller, so that the maximum transfer rate for an individual port may decrease significantly. Another drawback is the limited USB 3.0 cable length, which restricts this solution to compact systems.

EKF offers an advanced USB 3.0 interface card, which provides four independent USB controllers for a sustained data transfer rate of 4 x 5Gbps (SBX-DUB). With the additional use of rear I/O modules, up to 16 cameras can be attached. For lower performance requirements a single USB controller card is also available (SB3-TONE). Each USB port can supply up to 1.5A/5V; an electrical switch prevents from damages caused by external short-circuit or overload.

Camera Link (6.8Gbps)

The Camera Link (CL) interface has a long tradition and is still popular today. Depending on the configuration, different transfer rates of 5.44 Gbps (Full) or 6.8Gbps (Deca) are achievable. Proprietary interface cables are required for attachment of a CL camera to the CL frame grabber, with restrictions in length.

A Camera Link interface card (aka frame grabber) including software is also available for CompactPCI® Serial. The solution shown below from Active Silicon can be used within EKF systems without any issue. E.g., the frame grabber had been successfully integrated into an automated sorting plant application.

10Gb Ethernet

As an advantage of an Ethernet attached camera, use of the existent networking infrastructure can simplify the system installation. With a CAT6A copper cable length up to 100m (10GBASE-T), significantly higher distances can be achieved compared to USB and Camera Link solutions.

For 10GbE, the SFP+ port is the most popular interface connector, typically used with fiber optics. Inexpensive transceivers for multi-mode plastic fiber are available for a cable length of up to 300m (10GBASE-SR).

With single mode fiber transceivers (10GBASE-LR) cable lengths of up to 20km are possible. The SN5-TOMBAK is a dual port 10Gb Ethernet controller with two SFP+ ports. Compared to USB3.0, 10Gb Ethernet provides twice the data transfer rate. For compact systems also SFP+ twinaxial copper cables can be used.

If 10GBASE-T is required, EKF offers the SN3-GONG, a dual port 10GbE NIC with RJ45 front panel connectors for CAT6A cabling solutions.

http://www.ekf.com/s/sn5/img/sn5_10gb_camera_10x15.jpg

http://www.ekf.com/s/sn5/sn5.html

PCI Express® (20Gbps)

http://www.ekf.com/s/sx2/img/sx2_pcie_camera_10x15.jpg

http://www.ekf.com/s/sx2/sx2.html

Top-end image processing applications are PCI Express® enabled. This solution offers the shortest latency time, as well as very high data transfer rates. Similar to 10GbE, active optical cables (AOC) are available to cover distances up to 300m.

The SX2-SLIDE is a dual port PCIe x4 (Gen 2) interface with PCI-SIG specified front panel connectors. The nominal data transfer rate for each port is 20Gbps. EKF has plans for a PCIe Gen 3 solution which would deliver up to 32Gbps, or even 64Gbps with a PCIe x8 port.

Graphics Controller

Graphic solutions are also available for embedded systems, which offer reasonable performance at modest power consumption. AMD and Nvidia both offer GPU modules for industrial systems based on the MXM 3.0 standard.

The EKF SV2-MOVIE is a MXM 3.0 carrier board, suitable for a type A or type B form factor module. As an alternate application, accelerated parallel computing with multiple Nvidia GPUs based on the CUDA programming platform has become very popular.

http://www.ekf.com/s/sv2/img/sv2_0100_4te_halboffen_graphics_15x15.jpg

http://www.ekf.com/s/sv2/sv2.html

Processing Performance

Images captured and transmitted with high data rates need to be processed and saved in real-time. Therefore sufficient CPU throughput is required. EKF CPU Boards for the CompactPCI® Serial system slot are equipped with proven and reliable Intel® IoT high end processors, e.g. Core™-i7 or XEON®.

Saving and retrieving high speed data - its no magic. M.2 style SSD modules achieve an outstanding performance up to 1500MByte/s for sequential write. EKF offers different mezzanine solutions based either on the classic SATA interface (optionally with hardware RAID support), and also NVMe (PCIe x4 Gen3).

Enclosure

CompactPCI® Serial systems typically are based on proven 19-inch chassis components. For compact applications, EKF offers small enclosures down to five slots for the CPU card and peripheral boards.

Removable power supplies are available for AC or DC line input. Besides the interfaces for image processing discussed in this article, EKF offers CompactPCI® Serial peripheral boards for almost any industrial application.

Conclusion

With a focus on cost-efficiency, USB 3.0 based image capturing in compact systems may be a good choice. Many proven existing applications still require Camera Link. 10Gb Ethernet is based on standard networking technology, with reasonable high transfer rates and point-to-point cable lengths up to 20km. PCI Express® however opens the door to highest image resolutions and transfer rates.

For all kinds of applications, CompactPCI® Serial systems can be equipped with the suitable interface. System integrators can chose from a variety of versatile and proven boards, for a rapid realisation of their vision machine or any other individual industrial application. EKF high performance embedded computing based on CompactPCI® Serial can help to overcome previous limits.

Links to Pictures and Manufacturers	
Title Image Vision 5G - 20G	http://www.ekf.com/applications/vision/vision_30x30.jpg
CompactPCI® Serial System Exploded View	http://www.ekf.com/s/srs/srs3201/img/backplane_fci_sl4_su4_sk3_sv1_sc2_separate_10x15.jpg
Picture USB 3.0 USB 3.0 Camera SBX-DUB USB 3.0 Controller	http://www.ekf.com/s/sbx/img/sbx_usb_camera_10x15.jpg https://www.ximea.com http://www.ekf.com/s/sbx/sbx.html
Picture Camera Link Camera Link Frame Grabber Camera Link Camera	http://www.ekf.com/applications/vision/camera_link_10x15.jpg https://www.activesilicon.com http://www.stemmer-imaging.de/de/
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Image Enclosure SRS-BLUBOXX	http://www.ekf.com/s/srs/srs3201/img/bluboxx_dc_2016_pano_rechts_15x15.jpg http://www.ekf.com/s/srs/srs3201/srs3201.html

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