

„Now tell me, how do you take standards?“

The million dollar question concerning USB3 Vision

At the Vision 2009 USB 3.0 feasibility studies had been introduced by some camera manufacturers. Two years later at the Vision 2011 the first models were introduced while a kick-off meeting was simultaneously held about the future standard USB3 Vision. But how does this fit together? Can some manufacturers see into the future or are they going it alone? Is there a need for a USB vision standard at all? The following article sheds some light on the subject and shows why USB3 Vision is important for the image processing market.

First of all, all image processing manufacturers agree on one point: the announced sensors for 2012 allow faster cameras with higher resolutions and will need more bandwidth as a result. In SuperSpeed mode, USB 3.0 offers a bit rate of 5000 Mbit/s and surges the next generation of the successful standard interface to the same level as all other current and future consumer image processing interfaces (see table 1).

Table 1: The next generations of image processing consumer interfaces

Interface	Gross bandwidth [Mbit/s]	Net bandwidth [Mbit/s]	Cable length [m]	Introduction
USB 3.0	5000	300 + x*	3.5 (in practice: up to 8m passive)	2010 (Interface) 2012 (USB3 Vision)
Dual GigabitEthernet (Dual GigE)	2000	240	100	2008** (Interface) 2012 (GigE Vision)
10-GigabitEthernet (10GigE)	10000	1000	100	2004 (Interface) 2012 (GigE Vision)

* Limited by the USB 3.0 controller used

** Using Link Aggregation

Current market penetration

According to the AIA's 2010 market survey, the market share of digital cameras was about 50% in the machine vision sector whereas FireWire cameras (IEEE1394) have been approx. 40%, GigE Vision cameras 30%, CameraLink cameras 16% and cameras with other interfaces 14%. Presumably most of the 14% is represented by USB 2.0 cameras. However, there is no question that USB cameras are more prevalent in other image processing fields like medicine.

Why USB 3.0 solutions?

It is notable that the market share of USB cameras is disproportionate to the high availability of the USB interface. Many manufacturers attribute this to the fact that there is no USB vision standard available. Market figures back this up: currently the GigE Vision interface and its cameras have the highest growth rates with no end in sight. The question arises whether there is a need for USB 3.0 solutions at all. The image processing market is very heterogeneous and for this reason there are also application areas for USB 3.0. The compact USB cameras are suited for applications with short distances like in medicine, microscopy or easily scalable multiple camera solutions. The USB 3.0 standard is especially well suited for multiple camera solutions by using bidirectional cables and by eliminating device polling. Consequently, USB 3.0 is a perfect alternative to FireWire. In addition, the availability of USB 3.0 interfaces is very attractive. It is estimated that within the next two years USB 3.0 will become available on most PCs out of the box.

Why a USB 3.0 vision standard and what are the advantages?

In a nutshell, without standards every camera manufacturer does their own thing and many advantages customers learned to love with the GigE Vision standard would be lost. In order to prevent such a situation, more than 20 companies have joined to set the course for a successful future of the USB 3.0 interface by having a common USB3 vision standard. The know-how of all these 20 companies is tremendous because most also played a significant role in the development of GigE Vision. The inclusion of accessories manufacturers like cables, for example, is an indication that they're thinking of everything. In contrast to GigE Vision, this time the mechanics (e.g. lockable cable connectors) are part of the standard which all in all leads to a more robust interface.

Otherwise, like GigE Vision, USB3 Vision defines a transport layer, which controls the detection of a device ("Device Detection"), the configuration ("Register Access"), the data streaming ("Device Detection"), and the handling of events ("Event Handling") and establishes the interface to GenICam (Figure 1). GenICam again abstracts the access to the camera features for the user. The features are standardized (name and behavior) by the "Standard Feature Naming Convention" (SFNC).

Additionally, it is possible to create specific features in addition to the SFNC to differentiate from other vendors ("Quality of Implementation"). MATRIX VISION, for example, offers camera-specific features like frame average, flat field correction, logic gates, etc., for the GigE Vision camera mvBlueCOUGAR-X. These features are accessible by other GenICam / GigE Vision based driver and software solutions of other vendors.

Although GenICam has a standardized transport layer named GenTL, there is no driver support for embedded systems. Additionally – and this is the crux of the matter with USB 2.0 and all current available USB 3.0 special solutions – a proprietary driver is necessary between the host and the device. Ultimately this is undesirable for both customers (see current market situation of USB 2.0) who do not want to be tied to a manufacturer and the producers of software libraries. The latter complain that in the case of a system crash, customers won't know whether the proprietary driver or the software library was to blame. This is a further reason why USB3 Vision is defined "on-the-wire" like all other standards (Figure 2). Everybody is familiar with the advantages of "on-the-wire" standards: USB sticks, USB mice or USB hard disks – just plug and play them. It will also be easier for producers of image processing libraries. As soon as the software supports USB3 Vision, it can be used with all USB3 Vision compliant cameras. Thus, the proprietary bindings between hardware and software manufacturers will be a thing of the past. For the customers there will be an easy to integrate and wide range of software.

What is the roadmap for the USB3 vision standard?

After the kickoff meeting at the Vision 2011 and a second meeting in February 2012, the first draft is planned for the second quarter of 2012. The first release of the standard will be available at the Vision 2012. This timing is ideal because by then the technology will be broadly available. The first products will be available at the same time as there will be a "plug fest" just before the trade fair to guarantee the maturity of the interface and the products.

What USB3 Vision products are planned by MATRIX VISION?

MATRIX VISION is planning a product family like the successful, tiny mvBlueFOX-IGC CMOS camera family. There will be both CMOSIS sensors (2 Mpixels up to 150 fps and VGA up to 600 fps) and Aptina sensors (14 Mpixels).

Conclusion

Standards have always led to improvements, as was the case with the vision standards GenICam, CameraLink, GigE Vision, and now the future USB3 Vision. Customers will benefit from the liberty to choose and combine hardware and software as soon as they support standards like USB3 Vision. They will no longer be tied to a manufacturer. This is possible because of the GenICam foundation which offers further advantages: Firstly, existing image processing platforms can be reused. Secondly, a change of the transport layer like from GigE Vision to USB3 Vision can be managed easily and thirdly systems with several different transport layers are possible. Nevertheless, products won't

become indistinguishable from one another. By using the "Standard Feature Naming Convention" (SFNC), manufacturers can develop their own hardware-based features to stand out from other manufacturers. Since USB3 Vision is defined as „On-the-wire“, plug'n'play will be possible without proprietary drivers. Because of the GigE Vision experience, the maturity of the interface and the products will be ensured by the Vision 2012, with regard to the mechanics as well. The customer will be glad to hear this, especially when he is searching for products and can use the million dollar question „Now tell me, how do you take standards“.

Authors:

Dipl.-Ing. Horst Mattfeldt, director standard products, MATRIX VISION, Oppenweiler
 Dipl.-Ing. (FH) Uwe Hagmaier, manager product development, MATRIX VISION, Oppenweiler
 Dipl.-Ing., B.Eng (Hons) Stefan Battmer, development, MATRIX VISION, Oppenweiler
 Dipl.-Inform. (FH) Ulli Lansche, technical editor MATRIX VISION, Oppenweiler

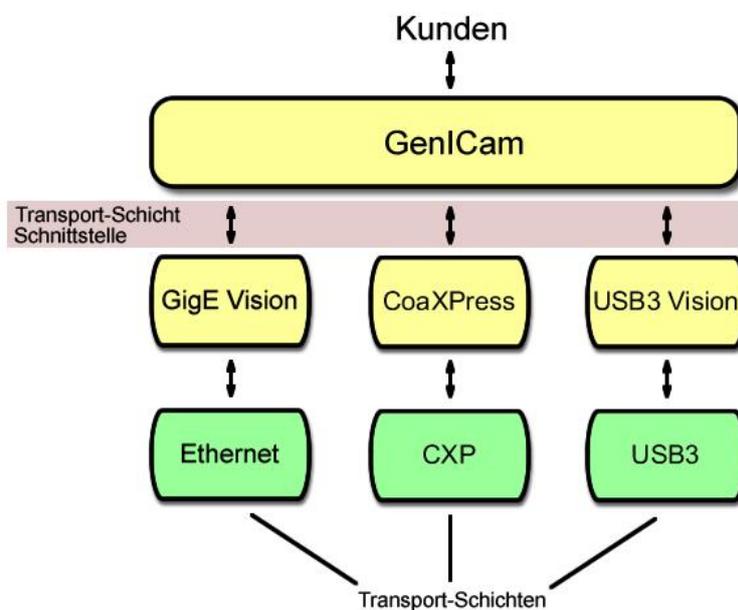


Figure 1: *GenICam-Standards.tif* With GenICam, customers can change the transport layer or combine different transport layers.

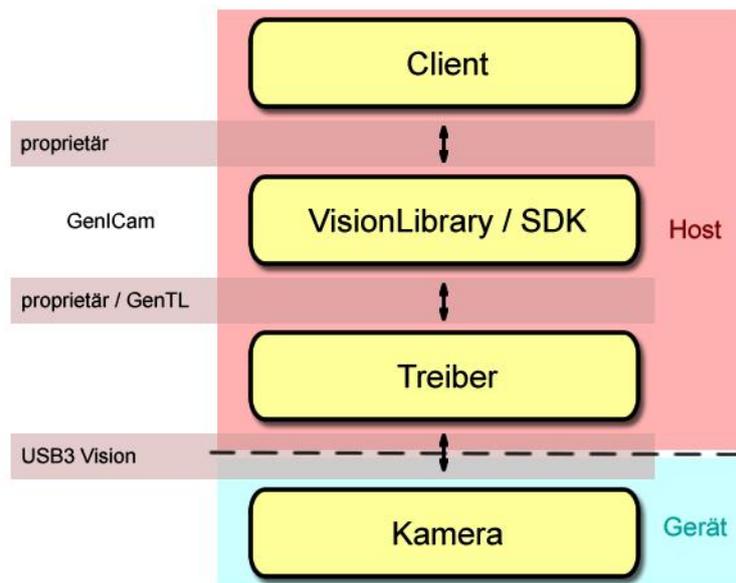


Figure 2: *OnTheWire-Standards.tif* Like all major standards in the image processing market, USB3 Vision is defined „on-the-wire“.



Figure 3: *mvBlueFOX-IGC H1 4c 300.jpg* MATRIX VISION's future USB3 Vision product will be inspired by the mvBlueFOX-IGC.