Baumer Dual GigE doubles the standard GigE bandwidth

The highest data transfer of 240 MB/s is creating the prerequisite condition for the data transmission needed by the most advanced sensors.

GigE Vision® as an established interface standard

The Gigabit Ethernet Interface has become established as the standard for digital image processing over the last few years. For cameras with advanced sensors, such as the SONY CCD matrix sensors used in numerous applications, the interface provides, for the first time, the possibility of using inexpensive standard network components and spanning distances of up to 100 m. In contrast to Camera Link® and FireWire™, the interface provides substantially more flexibility and permits the user to configure the application exactly for his needs. Multi-camera systems can be implemented simply and reliably using the IP/UDP protocol.

New sensors demand an innovative solution for higher transmission rates

Even though GigE Vision® has helped many applications succeed, this interface does have its limits. A network cable cannot transfer more than 120 MB/s. This limit is quickly reached by cameras with the newest sensors, such as the Quad Tap Kodak sensors, for applications requiring high image rates and high resolution at the same time. Camera Link®, also an established interface, can satisfy these demands but, its restrictions are a cable length of only 10 m and the need for sometimes high-cost frame grabbers. An innovative solution that increases the bandwidth is needed to completely exploit the advantages of GigE Vision®. One solution is the channel bundling of two Ethernet cables.

Channel bundling allows a transmission rate of 240 MB/s

A strategy for transmitting image data must be selected to implement channel bundling. In this strategy, the data must be divided onto two Ethernet cables, i.e., two channels. It would be possible to transmit one complete image or only one field on each channel. This would allow a direct transmission of the fields from sensors with, for example, two taps, which permit a faster image rate. With sensors having more than two taps, however, direct transmission of fields would no longer be possible. By alternating transmission of the images over both channels – one image

on each channel – the bandwidth used can be increased because of the essentially parallel transmission of the data but the latency would remain unchanged. This can only be reduced if each image is transmitted using alternating packets on both channels. The packets are divided simply on an alternating basis. In this scheme, the first packet is sent via the first channel and the second packet via the second channel. The third of packet again uses the first channel, and so forth. Consequently, the packet number of an image specifies the channel to be used. The challenge in this is maintaining the sequence of the packets while using network components. The PC

software used would, if an incorrect packet sequence occurred, request that the out-of-date packet be resent. In certain circumstances, this process can be repeated so often that a complete image is lost. To avoid this, Baumer has reworked and optimized the strategy for resending the images in its GigE filter driver. The driver records the possibly incorrect sequence and prevents triggering the unnecessary resends.

Several Ethernet channels can be combined using the Link Aggregation Group (LAG)

Innovative cameras that utilize channel bundling have connections for two Ethernet cables. As soon as the GigE connection is established on both camera ports, both channels are automatically bundled if the network adapter is properly configured. Up to 240 MB/s are then available to the camera as the bandwidth for image data. The combined channels are represented using one MAC address and are assigned one common IP address. In this way, they are registered by the software as one image-generating network component. For applications having only one individual camera, dual-port boards that fit directly in a PC slot can be used.


Dual GigE camera of the Baumer SX series

Implementing multi-camera systems

However, if an application requires a multi-camera system, additional network components such as switches must be used. While some of the currently available switches permit devices with Link Aggregation Group (LAG) to be connected, these switches can only cancel channel bundling and transmit the data over one single channel to the PC. Continuing to send the data in separate channels is not possible because the switch used has no knowledge of the transmitted camera data and cannot ensure that the proper sequence
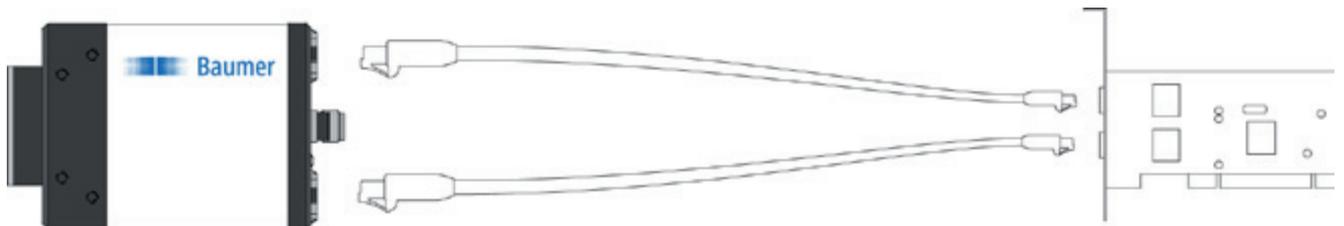
Connection possibilities
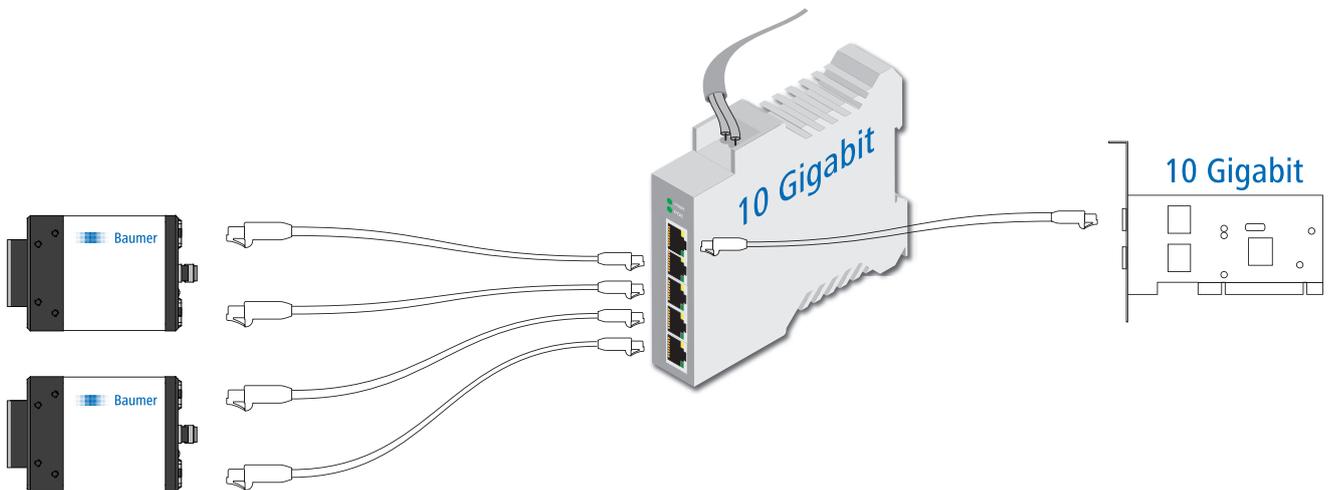
Channel bundling of Ethernet cables

of the packets is maintained. At the same time, the use of simple GigE switches creates a bottleneck because data arrive at the switch with the double bandwidth but can only be transmitted to the PC using the single bandwidth. One solution here is the use of 10 GigE switches that receive the bundled data from the individual cameras and transmit the data to the PC via one single connection having a maximum bandwidth of 1200 MB/s.

The Baumer SXG cameras with advanced Kodak sensors

With the innovative SXG cameras, Baumer is offering for the first time powerful industrial cameras that include the Link Aggregation method. The Dual GigE Interface ensures full use of the advanced Quad Tap sensors from Kodak. They provide image rates of up to 120 images per second with resolutions of 1, 2, 4 and 8 megapixels. As a result, they are suited to demanding image processing applications not just because of their high speed but precisely because of their outstanding image quality. Baumer is the first camera manufacturer to go one step further. Besides offering the external power supply, Baumer also makes it possible to supply power to the cameras using Power over Ethernet. In this case, only one of the two Ethernet ports needs to be supplied with power. This can be implemented most easily using a new dual-port board with an integrated Power over Ethernet power supply, also offered by Baumer. As an alternative, Baumer also provides an industrial injector with its GigE Power Series. This device can be installed simply and without problems into a control cabinet using the integrated the top-hat rail mount. The SXG cameras from Baumer implement the GigE Vision® 1.2 standard and are also designed for the simple integration of future standards.

High reliability and flexibility

Baumer cameras with the Dual GigE interface can be used in different configurations depending on the application. One advantage of the Dual GigE technology is its high reliability. Should the connection of one of the two net work cables be disconnected during dual operation, the camera is prevented from logging off the PC. However, the transmission speed is reduced to the normal GigE bandwidth in this case. This configuration can also be used for applications making use of the high resolution of the SXG cameras but where speed is not an important factor.

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