

White Paper: GigE Vision – Setting Standards

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One of many interfaces alongside FireWire, FireWireB, USB2, CameraLink, and now USB3 and CoaXPress, GigE Vision has been rapidly growing and has established itself as one of the interfaces of choice in the machine vision world. What makes this interface so popular with system integrators? What is the future for GigE Vision?

High standards

Gigabit Ethernet, or GigE, is a particularly fast version of Ethernet. At 1000 megabits per second (Mbps), Gigabit Ethernet is much faster than Standard Ethernet (10 Mbps) and Fast Ethernet (100 Mbps) and is capable of streaming uncompressed image data and providing reliable transmission from a camera to a host computer in real time at speeds that exceed the requirements of most industrial machine vision applications.

Similarly to FireWire with DCAM (IIDC), Gigabit Ethernet is regulated by its own standard. The GigE Vision camera control registers are based on a command structure called GenICam which is administered through the European Machine Vision Association (EMVA). The GigE Vision standard, thanks to its common camera control interface ensures that all GigE Vision compliant cameras are fully compatible with all third-party software and hardware, thus offering great value for reducing system integration costs and improving ease of use.

Simplicity and high performance

Since the introduction of GigE Vision, system integrators have begun transitioning from analog to digital interfaces due to obsolescence, higher performance and plug-and-play capabilities. GigE Vision is very popular with system integrators because it combines many features that are unavailable in other camera interfaces such as high data rate (required for uncompressed video or imaging applications), low cost cabling, plug-and-play capability and ubiquitous computer interface hardware that negates the need for special interface cards or expensive and complicated frame grabbers in order to operate a machine vision camera.

GigE Vision in practice

The range of GigE Vision compliant cameras available to system integrators (low to high resolution, fast frame rates, single-board, periscope-type cameras, compact to ultra-compact housings), make the GigE Vision standard ideal for virtually every machine vision application from industrial inspection to traffic imaging, OEM applications, intelligent traffic systems (ITS), public security imaging, aerial photography and many more.

Gigabit Ethernet provides a high performance camera interface that is able to convey control and image data over long cable lengths by far exceeding those of Camera Link, FireWire or USB. Cable lengths of up to 100 meters long using low-cost CAT5e or CAT6 cabling are possible, or even longer using switches or fiber optics. This feature is especially useful for outdoor installations, such as open road toll booth, traffic enforcement and specialized security where cameras may need to be mounted on poles or buildings and where the cable must be routed around the site to the host computer(s).

Thanks to its compatibility with standard Ethernet hardware, GigE Vision allows the unlimited networking of machine vision cameras, a feature particularly useful for expanding the Field of View or facilitating multiple views of the same scene using multiple cameras. In addition, GigE's 1000 Mbps bandwidth allows users to share a single Ethernet port between multiple cameras using a switch; minimizing the integration effort required while being able to support more cameras at higher resolutions and frame rates than competing digital interfaces.

Along with many other new features introduced by GigE Vision, multicasting is particularly unique. This mechanism facilitates simultaneous image data transfer to multiple computers connected to the camera network. This is especially useful for distributing the image processing load across several computers, allowing one PC to be responsible for image display and overlay while another PC is focused on gauging, defect detection, image logging, character recognition, etc.

GigE Vision's bright future

The machine vision market has recently seen the introduction of new interfaces such as USB3 and CoaXPress. To compete with these connectivity options GigE vision camera vendors are developing unique solutions for facilitating power over the interface and expanding bandwidth.

- **Power Over Ethernet (PoE)**

PoE technology is an existing standard which offers the transfer of electrical power along with data over standard Ethernet cables such as CAT5e. More recently, the IEEE has ratified the 802.3, a standard which supports PoE on Gigabit speed networks and increases its power capacity beyond 30 Watts. Some camera vendors have chosen to incorporate PoE into the camera while others have decided to minimize camera size and costs while offering a separate accessory in the form of a PoE splitter. This approach allows system integrators to bring power to additional devices near the remote camera installation such as temperature and pressure sensors, actuators and lens controllers, while communicating with these components via an RS232 port for instance, commonly found in machine vision cameras.

- **Dual-Port cameras – 240 MB/s**

To support the latest high resolution and high frame rate sensors being released by sensor manufacturers several camera vendors have developed cameras with two GigE ports for image transfer. The approach uses Link Aggregation (LAG) to combine multiple gigabit Ethernet ports into a single image and data transfer channel. Cameras that offer dual ports and support LAG are able to provide a sustained data rate of 2000 Mbps, double the effective bandwidth of traditional GigE and nearly triple that of FirewireB. Continuing its reliance on standard off the shelf hardware, LAG based GigE cameras maintain plug and play capabilities and continue adding value to the digital interface machine vision market.

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