

Application note: About GigE Vision

Background

Camera interface standards for machine vision cameras have evolved over the last ten years. A decade ago, industrial digital cameras were very difficult to install and integrate into machine vision systems. The difficulty was largely because there were no camera interface standards. System integrators and end users desperately needed something more standardized.

From Cameralink to DCAM

In the late 90's, the AIA formed a camera interface standard based on channel link, a parallel bus designed particularly for laptop computer displays. By defining a standard cable and connector, together with some standardized signal assignments, the Cameralink™ standard was born. Around the same time, IEEE-1394 firewire cameras were conforming to a digital camera interface standard called DCAM, now more commonly known as IIDC. The DCAM (IIDC) camera interface standard went further than Cameralink in that it not only defined a standardized hardware interface but also defined a standardized software control interface making DCAM-compliant firewire cameras truly plug and play. Until recently, these two interfaces have dominated the industrial digital camera market.

GigE Vision for high performance

The AIA GigE Vision™ standard for Gigabit Ethernet cameras has now become the state of the art interface for high-performance digital cameras for machine vision and industrial applications.

What is GigE?

GigE, or Gigabit Ethernet, is a particularly fast version of Ethernet which everyone knows and loves. Everyone is familiar with Ethernet because it is the ubiquitous means of connecting a computer to a network.

1000 Mbps

Standard Ethernet has a maximum data rate of 10 megabits per second (Mbps) and Fast Ethernet has a maximum data rate of 100 Mbps, but Gigabit Ethernet is much faster at 1000 Mbps. Standard Ethernet and Fast Ethernet are too slow for streaming uncompressed image data, and way too slow for machine vision cameras. Gigabit Ethernet (GigE), however, with its maximum data rate of 1000 Mbps, or 1 gigabit per second (Gbps) is capable of handling streaming image data and providing reliable transmission of image data from high performance machine vision cameras.

What is GigE Vision?

GigE Vision vs Gigabit Ethernet

The GigE Vision™ standard from the AIA is an interface standard for high-performance machine vision cameras that is widely supported in the industrial imaging industry. GigE (Gigabit Ethernet), on the other hand, is simply the network structure on which GigE Vision is built.

The GigE Vision Standard

The GigE Vision standard includes both a hardware interface standard (Gigabit Ethernet) and standardized means of communicating with, and controlling, a camera. The GigE Vision camera control registers are based on a command structure called GenICam which is administered through the European Machine Vision Association (EMVA). GenICam seeks to establish a common camera control interface so that third party software can communicate with cameras from various manufacturers without customization. GenICam is incorporated as part of the GigE Vision standard, so any truly GigE Vision-compliant camera also complies with GenICam. GigE Vision is analogous to Firewire's DCAM (IIDC) and has great value for reducing system integration costs and for improving ease of use.

Benefits of GigE Vision

GigE Vision is quite exciting because it provides many features that are unavailable in other camera interfaces. The combined features of high data rate (required for uncompressed video or imaging applications), ubiquitous computer interface hardware, low cost cabling, and widespread popularity make Gigabit Ethernet an attractive interface option for machine vision cameras.

Here are a few of the compelling benefits of GigE Vision-compliant cameras:

- Gigabit Ethernet ports are common on PCs and laptop computers, so there is no need for special interface cards or expensive/complicated frame grabbers in order to operate a GigE Vision camera.
- GigE provides high bandwidth to transmit uncompressed image data from a camera to a host computer in real time at speeds that exceed the requirements of most industrial machine vision applications. This negates the need for complex and expensive interfaces like Cameralink.
- Gigabit Ethernet provides a high performance camera interface to convey control and image data over long cable lengths. Cable lengths up to 100 meters long using inexpensive CAT5e cabling are possible. Even longer distances are possible using

switches or fiber optics. Such long cable lengths far exceed the maximum cable lengths of Cameralink, firewire, and USB.

- GigE Vision is compatible with standard Gigabit Ethernet hardware allowing networking of cameras. This is especially useful in situations requiring multiple views and opens up new machine vision applications in Intelligent Traffic Systems (ITS) and public security imaging.
- GigE Vision allows multicasting of image data simultaneously to multiple computers for distributing the image processing load across separate computers.
- CAT5e or CAT6 Ethernet cables can be easily manufactured on-site using low cost cabling and tools. This feature is especially useful for outdoor installations where cameras may be mounted on poles or buildings and where the cable must be routed as the site demands.
- The new GigE Vision standard provides ease of use that surpasses other common camera interfaces.
- The fast successor to GigE, 10GigE, offers 10 gigabit per second (Gbps) data rates that when applied to cameras means that parallel interfaces like Camera Link are no longer necessary even for high-speed applications

GigE Vision cameras vs other Gigabit Ethernet cameras

GigE Vision cameras supply uncompressed image data in real time, usually at very high data rates, that is suitable for image analysis.

Uncompressed data vs compressed data

Most other types of Ethernet camera are not suited to machine vision because they supply only compressed image data, and that only at very limited data rates. Some so-called 'smart cameras' use Ethernet to transmit non-image data from the camera to a network, but these are generally application specific image sensors that are not suited to generalized imaging.

GigE Vision cameras are specially designed to handle the dataflow in dedicated hardware providing uncompressed, very fast, very reliable data throughput in a form that is suitable for computer analysis.

Allied Vision Technologies offers a wide selection of CCD and CMOS machine vision cameras that conform to the GigE Vision standard providing an ease of use and integration that has not previously been available.

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We invite comments or suggestions on this application note at any time.

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