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Technical Support

Technical Bulletin

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Title:	**Transitioning from the MVS-8500™ Series Frame Grabber to GigE Vision®**		

PURPOSE

This document is an informational guide to help transition applications from the MVS-8500 series frame grabbers (MVS-8504, MVS-8504e, MVS-8501, and MVS-8500Le) to GigE Vision. It describes the technical operating differences between the two acquisition technologies and provides software code snippets to help port an existing application.

TECHNICAL DETAILS

References

GigE Vision is a camera interface standard and framework for industrial cameras in transmitting high-speed video and control data over standard Ethernet networks. To learn more about the architecture and components that are comprised in the GigE Vision standard, the following links may be helpful.

GigE Vision GigE Vision Standard GenICam

Getting Started

It is recommended that you read the document titled GigE Vision User's Guide (GigEGuide.pdf) from your VisionPro® or CVL® documentation installation directory. This document provides all the details on getting started with installing and using GigE Vision.

It is also recommended that you read the document titled Wiring Guide (WiringGuide.pdf) from your VisionPro or CVL documentation installation directory. This document contains all the details on how to properly wire power, I/O, trigger, and strobe connections to a GigE Vision camera.

The GigE Vision User's Guide and Wiring Guide can also be found on Cognex Product Support.

Software Version

To use GigE Vision acquisition in VisionPro or CVL it is recommended to use VisionPro 7.0 or CVL 7.0 or higher. You can use earlier versions that support GigE Vision, but it is highly recommended to use the latest software with GigE Vision. Patch releases to GigE Vision are also available, so check the Cognex support web site for updates.

Camera Video Format

The MVS-8500 series frame grabbers support a wide range of monochrome and color cameras. The camera video format was based upon a specific Camera Configuration File (CCF) for each camera. The

CCF file sets up the camera to operate in a specific mode and configures the frame grabber to properly extract the pixel data from the analog video signal output by the camera.

GigE Vision supports a wide range of monochrome and color cameras. However, there are no CCFs for each specific camera. The digital data output by a GigE Vision camera is self-describing. That is, the camera provides all the information needed to construct the image instead of the CCF. There are a small number of video formats declaring whether to operate in monochrome of color mode. For a complete list of GigE Vision video formats supported see the documentation titled Camera Support for VisionPro. For a complete list of supported cameras see this Cognex product support site. The supported video formats are listed in Table 1:

Video Format String	Data representation
Generic GigEVision (Mono)	8 bits/pixel
Generic GigEVision (Bayer Color)	Bayer pattern color image, 8 bits/pixel
Generic GigEVision (Mono10)	10 bits per pixel unpacked, 2 bytes/pixel
Generic GigEVision (Mono12)	12 bits per pixel unpacked, 2 bytes/pixel
Generic GigEVision (Mono14)	14 bits per pixel unpacked, 2 bytes/pixel
Generic GigEVision (Mono16)	16 bits per pixel unpacked, 2 bytes/pixel
Generic GigEVision (Mono10Packed)	10 bits per pixel, 2 bytes/3 pixels
Generic GigEVision (Mono12Packed)	12 bits per pixel, 2 bytes/3 pixels
Generic GigEVision (RGB8)	24 bits/pixel (8 bits per color)
Generic GigEVision (YUV422 Packed)	16 bits/pixel average

Table 1: List of supported video formats for GigE Vision

Color Video Formats

The MVS-8504 frame grabber only supports true color 3-plane RGB 24-bit color images from color cameras such as the Sony DXC-390. Each of the color planes represents 8-bits of color for each of the R, G, and B color planes.

GigE Vision supports three different color models: Bayer color, specially formatted 24-bit RGB, and YUV 422 packed (requires VisionPro 6.2 and GigE Vision Acquisition Module PR2, or a later release). The 24-bit RGB color mode in GigE Vision is not true color 3-plane RGB as on the MVS-8500. The color is formatted differently and does not represent true color 8-bits per pixel as on the MVS-8500.

Cognex CVL software (but not VisionPro) supports special acquisition fifos on the MVS-8500 that allowed construction of true color fifo's to be constructed. These were useful in situations where an application wanted to acquire a true color image and then display them, since it requires no additional color conversion for display. If your application is using the class's ccRGB32AcqFifo or ccRGB16AcqFifo you can continue to use them with GigE Vision, but a software conversion from the GigE Vision color format into PackedRGB32 or PackedRGB16 format will occur internally. The application will use more CPU to perform this extra conversion. This operation may also slow down the frame rate. The performance impact is PC-specific, hence it is recommended to measure the performance impact on the PC used by the application.

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Acquisition Fifo Construction

Figure 1 shows that the construction of a GigE Vision acquisition fifo is very similar to one constructed for an MVS-8500 series frame grabber. Below is a VisionPro code snippet in C# showing the differences when programmatically constructing an acquisition fifo. The most important item to modify is the video format.

MVS-8500:

```
CogFrameGrabber8504s mFrameGrabbers = new CogFrameGrabber8504s();
CogFrameGrabber8504 mFrameGrabber = mFrameGrabbers[0];
String videoFormat = "Sony XC-HR70 1020x768 IntDrv (rapid-reset, shutter-sw-
EDONPISHAII) CCF";
ICogAcqFifo mAcqFifo = mFrameGrabber.CreateAcqFifo(videoFormat,
                                CogAcqFifoPixelFormatConstants.Format8Grey,
                                0,
                                true);
```

GigE Vision:

```
CogFrameGrabberGigEs frameGrabbers = new CogFrameGrabberGigEs();
CogFrameGrabberGigE mFrameGrabber = mFrameGrabbers[0];
String videoFormat = "Generic GigEVision (Mono)";
ICogAcqFifo mAcqFifo = mFrameGrabber.CreateAcqFifo(videoFormat,
                                CogAcqFifoPixelFormatConstants.Format8Grey,
                                0,
                                true);
```

Figure 1: Acquisition fifo construction using the a monochrome video format

In Figure 1, the MVS-8500 frame grabber is using a monochrome camera, hence the video format selected for GigE Vision was "Generic GigEVision (Mono)". The determination of which video format to use depends on the camera and video format (mono or color) that you are using on the MVS-8500 frame grabber.

Figure 2 shows an example using a color video format from a Sony DXC-390 camera and the equivalent when using a color RGB24 GigE Vision camera.

```
MVS-8500:
CogFrameGrabber8504s mFrameGrabbers = new CogFrameGrabber8504s();
CogFrameGrabber8504 mFrameGrabber = mFrameGrabbers[0];
String videoFormat = "Sony DXC-390 640x480 IntDrv (3 Plane Color) CCF";
ICogAcqFifo mAcqFifo = mFrameGrabber.CreateAcqFifo(videoFormat,
                                CogAcqFifoPixelFormatConstants.Format3Plane,
                                0,
                                true);

GigE Vision:
CogFrameGrabberGigEs frameGrabbers = new CogFrameGrabberGigEs();
CogFrameGrabberGigE mFrameGrabber = mFrameGrabbers[0];
String videoFormat = "Generic GigEVision (RGB8)";
ICogAcqFifo mAcqFifo = mFrameGrabber.CreateAcqFifo(videoFormat,
                                CogAcqFifoPixelFormatConstants.Format8Grey,
                                0,
                                true);
```

Figure 2: Acquisition fifo construction using a color video format

Camera Ordering

On the MVS-8504 frame grabbers there were 4 available camera ports numbered 0 through 3. Each camera could be assigned a camera port via the CogAcqFifo8504.CameraPort property in VisionPro, or in CVL through the ccCameraPortProp class.

In GigE Vision, each camera is a frame grabber and only has a single camera port. The camera IP address determines the order in which the GigE Vision cameras will be recognized at startup of the CVL or VisionPro application. The GigE Vision camera's IP addresses are sorted in ascending order, and this corresponds to the numeric camera ID shown in the VisionPro QuickBuild Image Source form control.

Note that, at the time of this writing, the ability is not supported to plug-in and recognize GigE Vision cameras after the application has started. All cameras must be present at the time the application starts up, in order for them to be used by the application.

The utility called the GigE Vision Configurator is used to create a GigE Vision network. In this utility, the IP address of the gigabit Ethernet adapters and cameras can be configured.

Acquisition Properties

On the MVS-8500 frame grabbers all acquisition properties were controlled through very specific interfaces dedicated to each feature. In CVL, this is done using the classes found in <ch_cvl/prop.h> (i.e. ccROIProp). In VisionPro, this is done using equivalent interface classes (i.e. ICogAcqROI). In VisionPro you can query an acquisition property to determine if the platform supports that feature; these are the Owned* acquisition properties found on the acquisition fifo class (i.e. CogAcqFifo8504).

Some of the acquisition properties used between the MVS-8500 and GigE Vision are the same, and no porting is required in an application. The few common acquisition properties supported are exposure, contrast, and brightness.

However, many other acquisition properties supported on the MVS-8500 frame grabbers are not directly supported on GigE Vision. Control of more advanced acquisition properties in GigE Vision is done programmatically using what is called "Custom Properties." See the section ***Acquisition Custom Properties***, which describes how to set camera specific acquisition properties for GigE Vision cameras.

Exposure

The setting of exposure is done through the same programmatic interface between MVS-8500 and GigE Vision. For VisionPro this is though the ICogAcqExposure property and in CVL from the ccExposureProp class. For example,

VisionPro: mAcqFifo.OwnedExposureParams.Exposure = 10;

CVL: fifo->properties().setExposure(value);

Contrast/Brightness

The setting of contrast and brightness is done through the same programmatic interface between MVS-8500 and GigE Vision. For VisionPro, this is through the ICogAcqContrast and ICogAcqBrightness properties and in CVL from the ccContrastBrightness class. For example,

VisionPro:
```
mAcqFifo.OwnedContrastParams.Contrast = 0.25;
mAcqFifo.OwnedBrightnessParams.Brightness = 0.25;
```

CVL:
```
fifo->properties().setContrast(value);
fifo->properties().setBrightness(value);
```

Mapping values of Contrast and Brightness from the MVS-8500 series frame grabber to GigE Vision is camera-specific depending on the make and model. At this time, there are no mapping tables available.

Acquisition Custom Properties

Camera-specific features on a GigE Vision camera are controlled through the OwnedCustomPropertiesParams interface in VisionPro. For convenience, the Image Source in QuickBuild presents a graphical user interface to the Custom Properties interface. Using this graphical user interface, you can easily view all the camera specific options available for the camera and set values for each writable property. Any properties set via the graphical user interface will be stored when the VisionPro application is saved. Figure 3 is an example of the Custom Properties user interface.

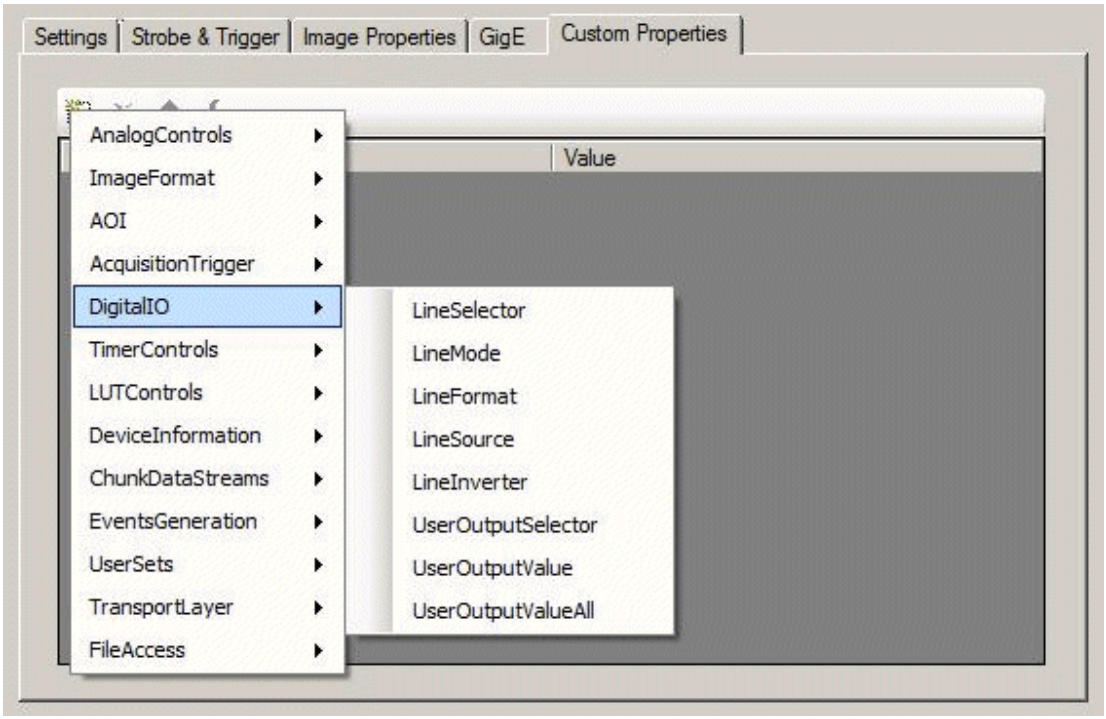

Figure 3: Custom Properties shown within QuickBuild Image Source

To control acquisition custom properties programmatically, there are several samples that ship with VisionPro. See the samples/Programming/Acquisition/GigEVisionProperties directory.

Control of GigE Vision custom properties using CVL is done through the ccGigEVisionCamera class using the read and write functions of that class. There are several programmatic samples that come with your CVL installation. See the files with the following names: samples/cvl/gige_*.cpp.

Master/Slave Acquisition

The MVS-8504 frame grabber supports simultaneous multi-camera triggering using a software mechanism known as master-slave. Master-slave configurations are created where one camera is deemed the master and up to 3 other cameras can be slaved to it (MVS-8504). When the Master received a trigger, the analog cameras' video timing would be automatically synchronized, causing acquisition to occur simultaneously on all cameras. The master-slave setup was configured programmatically using the VisionPro ICogAcqSimultaneous interface through the OwnedSimultaneousParams property, or in CVL using the ccTriggerProp class.

In GigE Vision, master-slave configuration through this programmatic interface is not supported. In some ways, achieving simultaneous triggering from multi-camera is simpler by wiring each camera to a common trigger source; thus there is no need to synchronize the video timing.

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PCIe Slots

Cognex recommends using a PCI Express (PCIe) gigabit Ethernet adapter when using GigE Vision. Gigabit Ethernet adapters can vary widely in performance. It is highly recommended to use gigabit Ethernet adapters that have been tested and resold by Cognex. Refer to the GigE Vision User's Guide to learn how to properly enable the Performance Driver and the controls settings in the adapter to obtain the best performance.

The number of cameras you were using with the MVS-8500 will determine how many gigabit Ethernet adapters will be required. A PCI Express slot will be required for each gigabit Ethernet adapter. Gigabit Ethernet adapters are commonly available in 1-port and 2-port options; in the future, 4-port options will be supported. Ensure that your PC has the proper number of PCI Express slots available.

Bandwidth

The theoretical bandwidth for GigE Vision is 1 gigabit/second or 125 megabytes/second. In practice, expect approximately 100 megabytes/sec per gigabit Ethernet port. If using a gigabit Ethernet adapter card that has multiple ports, be sure not to exceed the PCI or PCIe slot bandwidth that it is plugged into. Cognex recommends the use of PCI Express gigabit Ethernet adapters.

Cognex Drivers

The MVS-8500 series frame grabbers have a kernel level device driver in order to operate. The installation of this driver is done through the Cognex Drivers installation package. GigE Vision has a Performance Driver that can be installed. This Performance Driver can be installed from the GigE Vision Configurator utility or from the Cognex Drivers installer, depending on the version of VisionPro or CVL you are using.

Missed Triggers

The MVS-8500 can detect extra triggers and report them as "missed" triggers. GigE Vision does not support this. As an alternative solution, GigE Vision can provide a timestamp with each acquisition, and this may be used to detect triggering errors.

For an example of using time stamping with GigE Vision see:

CVL: sample/cvl/gige_timestamp.cpp

For an example on using time stamping in VisionPro QuickBuild, the following code snippet in Job Scripting can be used to obtain the time stamp on an image

```
public override bool PostAcquisitionRefInfo( ref Cognex.VisionPro.ICogImage image,
                                             Cognex.VisionPro.ICogAcqInfo info)
 {
     UInt64 timestamp = info.timeStamp;
     return true;
 }
```

Another alternative is to wire the trigger to both the camera and an I/O input line. Then the software can compare number of inputs versus the number of images received.

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Strobe

The MVS-8500 supports controlling of firing of the strobe line through the CVL or VisionPro programmatic interface. In GigE Vision, the strobe is driven by the camera and must be set up and controlled using CogGigEAccess class in VisionPro. To control these features in CVL, go through the ccGigEVisionCamera class. A VisionPro QuickBuild sample under the GigE Vision Camera Properties directory demonstrates how to enable the strobe on a GigE Vision Basler camera; see Basler Scout/Pilot Strobe.

Discrete Input/Output

With the MVS-8500 frame grabbers, there is the ability to control discrete input and outline lines directly through the programmatic interface. In CVL, this is done using the ccInputLine and ccOutputLine classes, and in VisionPro through the CogInputLines and CogOutputLines classes. The number of lines available depends on which type of MVS-8500 frame grabber is being controlled.

In GigE Vision, the programmatic interface to control discrete input and output lines is not supported. The GigE Vision standard does not have a common mechanism for controlling discrete input and output lines. Each GigE Vision camera controls these lines differently. Setting of the input and output lines may be controlled through the Custom Properties interface; refer to your GigE Vision camera manufacturer documentation to determine how to control the input and outline lines.

GigE Vision cameras typically have very few discrete input and output lines. In applications that require many discrete input and output lines (as many as offered on the MVS-8500 frame grabbers), you will need to use a 3rd party solution and integrate this into your application.

Cognex resells a 3rd party Discrete I/O board from Measurement Computing. This is a PCI- or USB-based board that is integrated into the VisionPro QuickBuild Communications Explorer user interface. A VisionPro programmatic interface to control this I/O board is also available; see the CogIOMCB class.

Note that VisionPro does not support the Measurement Computing Discrete I/O hardware on a Microsoft 64-bit operating system.

Power over Ethernet

Power is supplied to a GigE Vision camera in several different ways. Always refer to the manufacturer's documentation to learn how to properly power the GigE Vision camera. The Cognex Wiring Guide supplied with VisionPro and CVL software presents a graphical pictorial on supplying power to GigE Vision cameras. The three different methods include:

1. Some models, such as the Basler Ace, support Power over Ethernet (POE). Power is delivered to a camera through a standard CAT5E or CAT6 cable. Power is injected into the cable using a POE injector, POE switch, or a POE network interface card.

2. Most GigE camera models will accept power from a separate power supply, which is connected to an I/O port.

3. Most GigE cameras will also accept power delivered through the I/O cable.

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No matter which method is used to power the GigE Vision camera, the supply of power is unrelated to the software. There are no programmatic software interfaces that control the power of GigE Vision cameras for any of the methods described.

Cables

The MVS-8500 series has special cables depending on what type of cameras are being used. Those cables supplied trigger, strobe, and I/O lines from the camera to the frame grabber. In GigE Vision, there may be up to 3 different cables used: power, I/O, and Ethernet. Consult the Wiring Guide (WiringGuide.pdf) to learn how to configure power, I/O, and Ethernet to your GigE Vision camera.

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Camera Selection

Table 2 is a list of GigE Vision cameras from Basler that Cognex resells.

Cognex Product ID	Model	Resolution	Color/ Mono	Frame Rate (fps)	Sensor Size	Interlaced/ Progressive	Pixel Size (um)	Camera Dimensions WxHxL
CAM-ACE-640-90GM	Ace acA640-90gm*	659x494	Mono	90	1/3"	Progressive	7.4	29 x 29 x 42
CAM-ACE-640-100GM	Ace acA640-100gm*	640x480	Mono	100	1/4"	Progressive	5.6	29 x 29 x 42
CAM-ACE-750-30GM	Ace acA750-30gm*	752x582	Mono	30	1/3"	Interlaced	6.25	29 x 29 x 42
CAM-ACE-1300-30GM	Ace acA1300-30gm*	1296x966	Mono	30	1/3"	Progressive	3.75	29 x 29 x 42
(Release in Q3 2011)	Ace acA1600-20gm*	1628x1236	Mono	20	1/1.8"	Progressive	4.4	29 x 29 x 42
CAM-ACE-2500-14GM	Ace acA2500-14gm*	2592x1944	Mono	14	1/2.5"	Rolling Shutter	2.2	29 x 29 x 42
CAM-SCT-640-120GM	Scout scA640-120gm	659x494	Mono	120	1/4"	Progressive	5.6	44 x 29 x 73.7
CAM-SCT-640-74GM	Scout scA640-74gm	659x494	Mono	74	1/2"	Progressive	9.9	44 x 29 x 73.7
CAM-SCT-640-70GM	Scout scA640-70gm	659x490	Mono	71	1/3"	Progressive	7.4	44 x 29 x 73.7
CAM-SCT-750-60GM	Scout scA750-60gm	752x480	Mono	60	1/3"	Progressive	6	44 x 29 x 73.7
CAM-SCT-780-54GM	Scout sca780-54gm	782x582	Mono	55	1/2"	Progressive	8.3	44 x 29 x 73.7
CAM-SCT-1000-30GM	Scout scA1000-30gm	1034x779	Mono	30	1/3"	Progressive	4.65	44 x 29 x 73.7
CAM-SCT-1300-32GM	Scout scA1300-32gm	1296x966	Mono	32	1/3"	Progressive	3.75	44 x 29 x 73.7
CAM-SCT-1390-17GM	Scout scA1390-17gm	1392x1040	Mono	17	1/2"	Progressive	4.65	44 x 29 x 73.7
CAM-SCT-1400-30GM	Scout scA1400-30gm	1392x1040	Mono	30	2/3"	Progressive	6.45	44 x 29 x 73.7
CAM-SCT-1600-28GM	Scout scA1600-28gm	1628x1236	Mono	28	1/1.8"	Progressive	4.4	44 x 29 x 73.7
CAM-ACE-640-90GC	Ace acA640-90gc*	659x494	Color	90	1/3"	Progressive	7.4	29 x 29 x 42
CAM-ACE-640-100GC	Ace acA640-100gc*	640x480	Color	100	1/4"	Progressive	5.6	29 x 29 x 42
CAM-ACE-750-30GC	Ace acA750-30gc*	752x582	Color	30	1/3"	Interlaced	6.25	29 x 29 x 42
CAM-ACE-1300-30GC	Ace acA1300-30gc*	1296x966	Color	30	1/3"	Progressive	3.75	29 x 29 x 42
(Release in Q3 2011)	Ace acA1600-20gc*	1628x1236	Color	20	1/1.8"	Progressive	4.4	29 x 29 x 42
CAM-ACE-2500-14GC	Ace acA2500-14gc*	2592x1944	Color	14	1/2.5"	Rolling Shutter	2.2	29 x 29 x 42
CAM-SCT-640-120GC	Scout scA640-120gc	659x494	Color	120	1/4"	Progressive	5.6	44 x 29 x 73.7
CAM-SCT-640-74GC	Scout scA640-74gc	659x494	Color	79	1/2"	Progressive	9.9	44 x 29 x 73.7
CAM-SCT-640-70GC	Scout scA640-70gc	659x490	Color	71	1/3"	Progressive	7.4	44 x 29 x 73.7
CAM-SCT-750-60GC	Scout scA750-60gc	752x480	Color	60	1/3"	Progressive	6	44 x 29 x 73.7
CAM-SCT-780-54GC	Scout scA780-54gc	782x582	Color	55	1/2"	Progressive	8.3	44 x 29 x 73.7
CAM-SCT-1000-30GC	Scout scA1000-30gc	1034x779	Color	30	1/3"	Progressive	4.65	44 x 29 x 73.7
CAM-SCT-1300-32GC	Scout scA1300-32gc	1296x966	Color	32	1/3"	Progressive	3.75	44 x 29 x 73.7
CAM-SCT-1390-17GC	Scout scA1390-17gc	1392x1040	Color	17	1/2"	Progressive	4.65	44 x 29 x 73.7
CAM-SCT-1400-30GC	Scout scA1400-30gc	1392x1040	Color	30	2/3"	Progressive	6.45	44 x 29 x 73.7
CAM-SCT-1600-28GC	Scout scA1600-28gc	1628x1236	Color	28	1/1.8"	Progressive	4.4	44 x 29 x 73.7

Note: * denotes Power over Ethernet

Table 2: Basler GigE Vision camera resold by Cognex

Appendix

Comparison Chart

Table 3 is a comparison chart for a wide variety of features between the analog MVS-8500 series frame grabber and a digital GigE Vision camera.

Feature	MVS-8500	GigE Vision
Interface Specification Standard	None	GigE Vision (AIA)
Requires Custom Camera Configuration File	Yes	No
Supports Generic Video Formats	Yes	Yes
Color Images	Yes (True Color RGB)	Yes (Bayer, YUV, and RGB planar)
Cables	Cognex custom	Standard CAT 6 with RJ 45 connector (recommended)
Cable Length	100+ meters	100+ meters
Interface Board	Custom PCI or PCI Express Frame Grabber	Standard gigabit Ethernet PCI Express adapter
Number of Ports per Board	Four MVS-8504 One on MVS-8501 Four on MVS-8504e One on MVS-8500Le	Single port adapter Dual port adapter Quad port adapter (future support)
Supports Switches and Hubs	-	Yes
Bit Rate	-	1000 Megabits/sec (theoretical) 800 Megabits/sec (practical)
Plug and Play	No	No (requires network IP configuration and association with adapter)
Requires Configuration Setup	No	Yes (using GigE Vision Configurator)
Number of Cameras (Simultaneous Acquisition)	Four on MVS-8504 One on MVS 8501 Four on MVS-8504e One on MVS-8500Le	One camera per port
Trigger and Strobe Connector	On Frame Grabber	On Camera (different for each camera vendor)

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Feature	MVS-8500	GigE Vision
Discrete Inputs/Outputs	Yes up to 16 inputs/16 outputs	Camera may have 1 input and 1 output (very limited) May need separate 3rd party I/O module
Supported on Microsoft 64-bit Operating System	No	Yes
Strobe Output	Yes	Generally Yes (but may be camera vendor specific)
Camera Power	Power from Frame Grabber	Separate camera power supply
Supports Line Scan	No	Yes
Driver	Kernel level Cognex custom Windows driver	Filter or Kernel level Cognex custom Performance Driver
Software Programming Interface	Supported by CVL and VisionPro API	Supported by CVL and VisionPro API
Supports Master/Slave	Yes (MVS-8504 only)	No
Low Level Software Access to Frame Grabber or Camera Properties	No (limited)	Yes (full access to XML on camera)
Can Control Bandwidth Usage per Camera	No	Yes
Can Get a Timestamp on Every Acquired Image	No	Yes
Reports Missed Triggers	Yes	No (consider using time stamping)
Support Acquisition Complete Callback	Yes	Yes
Support Move Part Callback	Yes	No
Image Acquisition Latency	Direct DMA (minimal latency)	Network Packet Transfer (some latency, but improving with newer versions of software)

Table 3: Comparing features between Cognex analog frame grabbers and digital GigE Vision