GigE Vision: Coming Soon to a Military Screen Near You

— by John Phillips, Pleora Technologies

Vision systems are playing an increasingly important role on the battlefield. Prized for their ability to improve surveillance while keeping troops out of harm's way, these systems are becoming the vital electronic "eyes" in a growing range of military operations.

Designers of military vision systems — which comprise sophisticated networks of sensors, cameras, computers, and software — face serious challenges, many of them unique to defense applications. First, to enable quick and accurate decision-making, the systems must be easy to use while still remaining sophisticated in their analysis. Second, they must be cost effective to deploy, maintain, and upgrade. Budget pressures demand that, wherever feasible, existing investments in cameras and sensors are preserved. Third, every effort must be made to reduce size, weight, and power (SWaP). And fourth, the systems must respect military performance requirements that guide purchasing and design choices.

A key part of the design process is choosing the video interface – the technology used to transfer data from a camera or image sensor to a mission computer or display. Although the video interface is only a small part of the overall vision system, it has a large impact on the complexity, cost, and performance of the final product.

Cost and performance advantages

Traditionally, military vision systems have used point-to-point interfaces to connect sensors and cameras to displays or computers. These umbilical connections, based on interfaces such as analog, Camera Link®, or low-voltage differential signaling (LVDS) standards, require a dedicated cable between each camera/sensor and its endpoint, whether that be a display or computer. In applications with numerous cameras/sensors and displays, such as a vehicle electronics (vetronics) system for a windowless ground vehicle, the cabling becomes costly, complex, heavy, and difficult to manage and scale. In addition, these interfaces require a PCI frame grabber at each endpoint to capture data, driving up cost.

Ultimately, these legacy interfaces complicate design. They limit component choice, increase costs, and result in more complex systems. To address these issues, military vision system designers are migrating to digital systems based on Gigabit Ethernet (GigE) video interfaces and infrastructure.

GigE is a natural choice for video transmission in military systems. It allows designers to fully support required point-to-point connections while gaining the flexibility of video networking, the ability to interwork with a range of different computing platforms, and the benefits of light-weight, low-cost, commercial off-the-shelf (COTS) Cat 5/6 cabling.

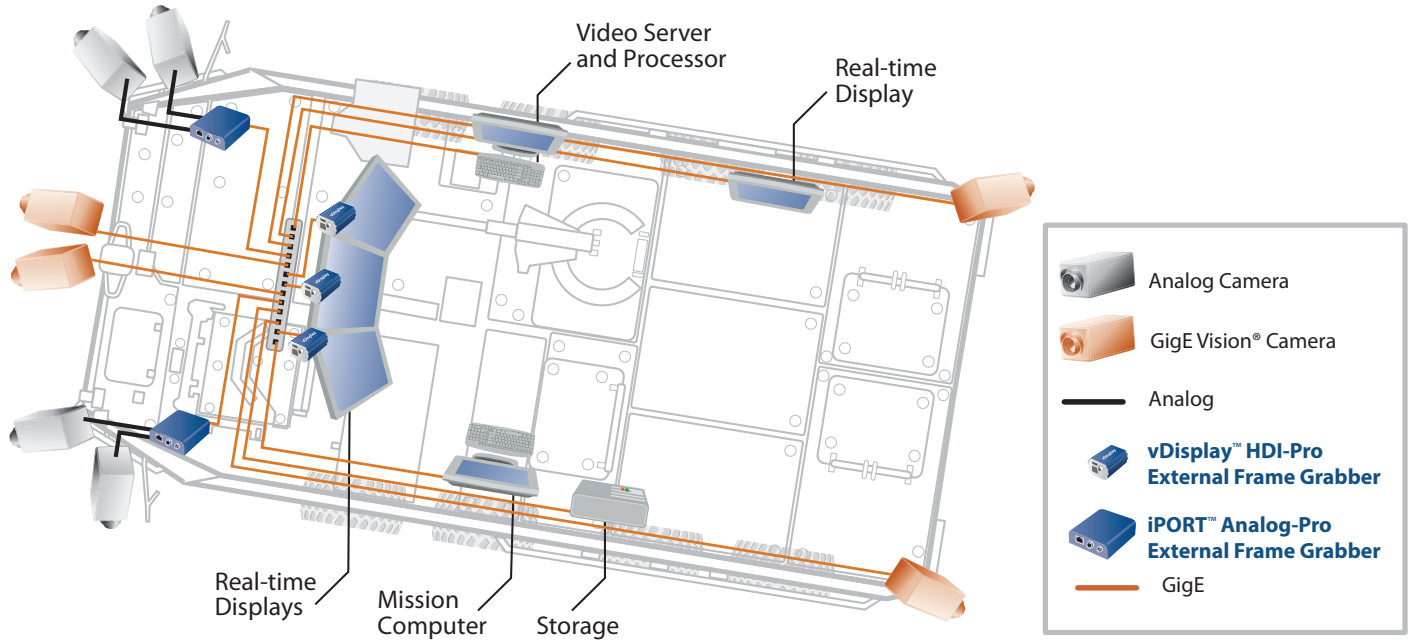

Figure 1: Video is converted to GigE Vision by an external frame grabber and streamed over the multicast Ethernet network to displays and processing equipment at various points within the vehicle.

Many military system designers who opt for GigE are basing their systems on the GigE Vision® standard. This standard, which regulates video transfer and device control over Ethernet networks, is widely supported by equipment vendors, making it straightforward to source COTS products that interoperate over the GigE platform. For vetronics applications, GigE Vision compliance helps meet the U.S. Army's Vehicular Integration for C4ISR/EW Interoperability (VICTORY) initiatives for vehicle network interoperability and COTS open-system standards. Moreover, some GigE Vision products — including a broad range of external frame grabbers, embedded hardware interfaces, and cameras — have been field-hardened in demanding industrial applications, making them appropriate for such applications as local situational awareness (LSA) in military vetronics.

Simplified cabling and flexible networking

GigE Vision implementations can achieve exceptional performance, transmitting uncompressed video between cameras/sensors and computers or displays with low, consistent "glass-to-glass" latency. The video, along with power and control data, is sent over Ethernet cabling to existing ports on the computer or display. Freed from the requirement for a peripheral card slot, designers can choose from a broad selection of ruggedized, small form-factor and low-power computing platforms for imaging processing and control.

The flexible, lighter, field-terminated Ethernet cables cost less and are simpler to install and maintain than the bulky cabling and connectors of legacy interfaces. Further, the flexible point-to-point and point-to-multipoint networking flexibility of GigE allows images from multiple cameras/sensors to be aggregated to a single port on a mission computer or processing unit, and/or imaging data to be multicast from one camera/sensor to multiple displays.

GigE Vision interfaces in a military ground vehicle

With GigE Vision-compliant video interfaces, designers can easily upgrade vision systems for military ground vehicles to integrate different types of cameras, displays, and processing computers into a single, all-digital, real-time video network.

In a local situational awareness (LSA) application (Figure 1, front page), real-time video from analog and digital cameras and sensors is transmitted to display panels for crew members to navigate the windowless vehicle and survey surroundings. Video from analog cameras is converted to GigE Vision at the source by an external frame grabber and streamed uncompressed over the multicast Ethernet network to displays and processing equipment at various points within the vehicle. Video, control data, and power are transmitted over the single cable; lowering component costs, simplifying installation and maintenance, and reducing "cable clutter" in the vehicle.

All computers used for processing and mission control connect to the network via their standard Ethernet port, eliminating the need for a computing platform with an available peripheral card slot. Instead, system designers can employ ruggedized laptops, embedded PCs, or single-board computers for image analysis and control to help lower costs, improve reliability, and meet SWaP objectives.

With all devices connected to a common infrastructure and straightforward network switching, multiple streams of video can be transmitted easily to any combination of mission computers and displays. Troops can decide "on the fly" which video streams they need to see, without any changes to cabling or software configurations, or use the on-board mission computer to combine images for use by others in the vehicle. For example, the video feed from visible light cameras can be converted to GigE and blended with video from a native GigE thermal camera to provide more detail on a region of interest. (Figure 2)

Beyond LSA systems, GigE Vision-compliant video interface solutions are ideal for vision systems for sighting, threat detection, weapons targeting, and surveillance in ground-based vehicles, naval vessels, manned and unmanned airframes, and standalone systems for persistent surveillance. Robotics manufacturers, for example, are employing GigE Vision-compliant wireless video interfaces to help reduce weight, lower power requirements, and extend battery life.

The video interface is a design cornerstone of all vision and imaging systems. For military applications, GigE Vision-compliant video interfaces enable new generations of vision systems that cost less, weigh less, and are easier to use than systems based on legacy point-to-point standards. They allow video to be easily networked and improve the ability of troops to stay out of harm's way. ✸

John Phillips is senior manager, product management with Pleora Technologies, a leading supplier of video interfaces for system manufacturers and camera companies serving the military, medical, and industrial automation sectors.

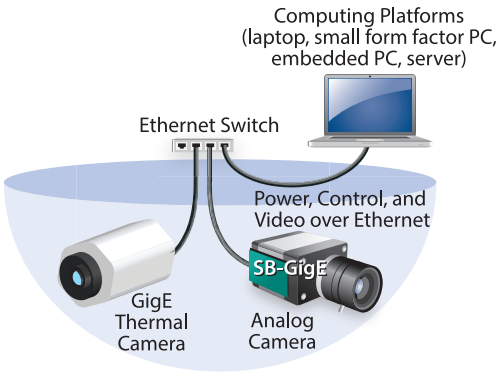

Figure 2: Images from an analog camera are converted into GigE Vision video and blended with video from a native GigE Vision thermal camera.