Video Interface Design Choices for the Networked Hospital

— by John Phillips, Pleora Technologies

From image-guided surgery to telepresence robots, imaging systems are playing an increasing role in healthcare. Real-time video can help enhance patient outcomes by supporting faster, more accurate decision making. Hospital administrators are also embracing imaging systems to increase efficiencies and reduce costs.

For imaging system designers, medical applications pose unique performance and cost challenges. While these systems must handle more complex imaging and analysis tasks, they must be easier to use for a range of hospital staff. Budget pressures and cost concerns means designers must upgrade system performance, often while preserving an end-user's investment in existing cameras, sensors, and processing equipment.

Although the video interface is only a small part of the overall medical imaging system, choosing the right solution to transfer data from a camera or image sensor to a PC or display has a large impact on the complexity, cost, and performance of the final product.

Vision Standards Simplify Design

Traditionally, medical imaging systems have used point-to-point interfaces based on proprietary, Camera Link® , or low-voltage differential signaling (LVDS) standards to connect sensors and cameras to displays or computers. These umbilical connections require a dedicated cable between each camera/sensor and its endpoint.

Developing proprietary interfaces is risky, expensive, and time-consuming, while the limitations of legacy interfaces drive up cost and system complexity. In applications with numerous cameras, sensors, and displays, 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. Ultimately, these legacy interfaces complicate design. They limit component choice, increase costs, and result in more complex systems.

This changed with the introduction of vision standards that simplify design, lower cost, and make it easier to install, upgrade, and maintain high-performance imaging devices. GigE Vision® and USB3 Vision™ standardize the delivery of video over more flexible, less expensive Ethernet and USB 3.0 cables. The GenICam™ standard, incorporated into a range of high-speed video standards including GigE Vision and USB3 Vision, provides a universal programming interface that ensures interoperability between cameras and imaging products in multi-vendor systems.

As these standards gain wide scale adoption, an increasing number of GigE Vision and USB3 Vision-compliant products are now available as off-the-shelf solutions from global vendors. These products allow system designers to integrate different types of cameras, displays, and processing PCs into a unified, real-time video network. For retrofit projects, external frame grabbers convert feeds from existing cameras into more manageable GigE or USB3 Vision compliant video. Embedded hardware solutions allow manufacturers to easily integrate standards-compliant video connectivity into cameras, x-ray detector panels, and imaging systems.

Complexity, Cost, and Performance Advantages

GigE Vision and USB3 Vision interfaces transfer imaging data from a camera or sensor over a single cable directly to Ethernet or USB 3.0 ports found in most computing platforms. Freed from the need for a PC with a peripheral card slot required for a traditional frame grabber, system designers can choose from a wider range of less expensive, lower power, smaller form factor computing platforms for control and analysis. This can lower component costs,

minimize footprint, and reduce system complexity.

The flexible, lighter Ethernet and USB cables cost less and are simpler to install and maintain than the bulky cabling and connectors of legacy interfaces. With the extended reach of Ethernet – up to 100 meters between network nodes over standard Cat 5/6 copper cabling— system designers can centralize processing PCs outside of the sterile operating room and more easily share data across departments. Imaging data can be multicast from one camera or image sensor to multiple displays over the switched Ethernet network, or images from multiple cameras can be combined on one processing unit.

USB3 Vision interfaces are suited for higher bandwidth, shorter distance applications, such as star topologies where multiple cameras are aggregated into a central PC used for control and image analysis. USB 3.0 cables have a typical reach of about three meters, with vendors now introducing repeaters and active optical cable solutions that significantly extend the potential distance between camera sensors and processing units.

With GigE Vision and USB3 Vision-compliant video interfaces, designers can fully support required point-to-point connections, while gaining the flexibility of video networking, the ability to interwork with a range of computing platforms, and the benefits of light-weight, low-cost cabling.

Versatile System Design: Designers can lower component costs, minimize footprint, and reduce system complexity by using smaller form factor computing platforms for control and analysis, such as embedded processors, single-board computers, laptops, and tablets.

Simplified Cabling: Lighter, more flexible Ethernet and USB cables cost less and are simpler to install and maintain than the bulky cabling and connectors of legacy interfaces. Video, control, and power can be transmitted over the single cable.

Cost-Effective Upgrade: External frame grabbers convert feeds from existing cameras into more manageable GigE Vision and USB3 Vision-compliant video streams, allowing manufacturers to preserve an end-user's investments in cameras, sensors, and processing systems. With embedded hardware solutions, manufacturers can easily integrate vision standards-compliant video connectivity into cameras, x-ray detector panels, and imaging systems.

Easy Networking: Flexible networking means imaging data can be multicast from one camera or image sensor to multiple displays, images from multiple cameras can be combined on one processing unit, and new cameras, displays, or computers can be added to the imaging system often with "plug-and-play" simplicity.

The use of standardized image transmission protocols is increasingly a "checkmark" for hospital administrators when evaluating imaging systems from different vendors. Designing or upgrading systems with off-the-shelf, vision standard-compliant video interfaces shortens time-to-market, reduces risk, and lowers system cost for manufacturers, while enabling performance benefits that enhance the value of solutions. ✹

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GigE Vision	USB3 Vision
Uses common Ethernet infrastructure (ports widely available on most computing platforms, cabling, network interface cards, switches)	Uses USB 3.0 ports common on most computing platforms and off-the-shelf cables
Data transfer rates up to 125 MB/s with GigE, and 1.25 GB/s with 10 GigE	Data transfer rates up to 375 MB/s
Cable lengths up to 100 meters; longer with widely available switches	Supports cable lengths up to 5 meters
Networking flexibility allows one camera to send video to multiple endpoints, multiple cameras to send video to one endpoint, or combinations of the two.	Supports "hot-plugging" and "hot-swapping" of components with automatic detection and software configuration, aggregate multiple cameras to a single USB 3.0 port using an off-the-shelf USB 3.0 hub
Ability to power cameras over the Ethernet cable (IEEE 802.3af Power over Ethernet)	Ability to power the camera over the USB cable

Table 1: GigE Vision and USB3 Vision standards simplify integration, maintenance, and interoperability of medical imaging systems.