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Why Smart Video Displays May Not Be the Cleverest Choice

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Video systems have been key to improving situational awareness on ground, air, and sea platforms for quite a few years now. Cameras and other sensors mounted on the exterior of the platform give operators critical visibility of their surroundings.

Figure 1: Land, air and sea vehicles depend on cameras for situation awareness

Some examples of this include:

- Military armored vehicle drivers rely on video to navigate, detect threats, and identify targets.
- Search and rescue teams rely on video to locate people in distress and operate rescue equipment.
- Police rely on video to help track suspects on the move.
- Border control agencies rely on video to monitor and secure borders.
- Utility companies rely on video to monitor remote power and gas lines.

Originally, video systems were comprised only of a camera and a video display. However, increasingly sophisticated adversarial threats and advances in video technologies led to systems that include multiple sensors and displays and the need for computer processing capabilities to combine and effectively route and display obtained imagery. When computer processing is added, video systems can manipulate video feeds to enable video blending and stitching, and they can layer regular camera feeds with infrared and thermal imaging. In addition, they can display mapping, telemetry data, and image metadata along with video streams.

When these advances first came along, it seemed logical to add computer processing capabilities to the back of the display screen. At the time, an all-in-one solution simplified cabling and installation requirements compared to distributed systems with a separate computing component. As a result, smart video displays became popular and were widely deployed.

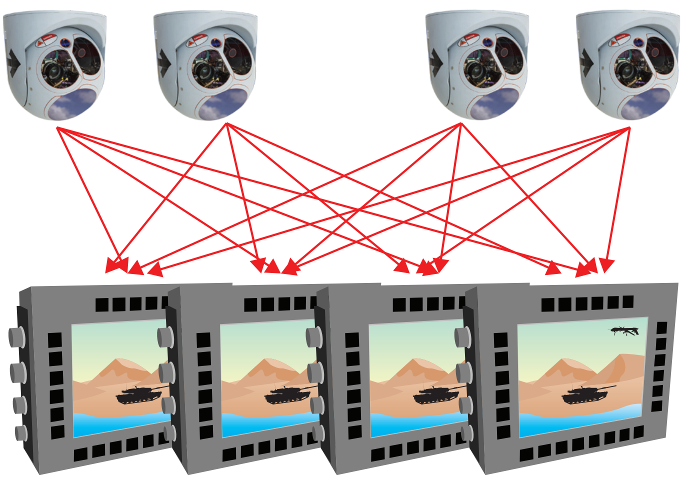

Figure 2: System architecture with smart display technology

Since that time, technology has continued to evolve, and all-in-one video display and computing solutions no longer have an obvious advantage over simple, standalone displays. In many cases, a simple video display connected to a separate computing component is the better choice. As a result, it is critical for anyone evaluating video displays to thoroughly consider their requirements and understand the advantages and disadvantages of smart and simple displays before choosing a solution.

Figure 3: System architecture with separate mission computer and displays

Key Considerations When Evaluating Video Displays

The first step is to determine which video technologies and capabilities are needed to complete mission tasks efficiently and effectively. This approach helps ensure operators can work in an intuitive and natural way, staying focused on the information provided rather than the technologies providing it. Key human factors to consider include:

- the natural and artificial light and its impact on screen visibility
- if the display can be adjusted to reduce glare and change brightness and contrast levels
- whether a touch screen provides the optimal ease of use
- whether users are likely to be wearing gloves when using the display controls or night-vision goggles when viewing the display
- the optimal screen resolution for the amount and types of information that must be simultaneously displayed

The next step is to consider broader factors such as size, weight, and power (SWaP), and budget constraints. Exceeding any of these factors has the potential to compromise, or even cripple missions. The final step is to step back even further and consider how the video display solution will operate with other vehicle systems and how long it is expected to remain a viable solution.

Number and Size of Displays Required

To determine the number and size of video displays required, consider the amount of information that must be simultaneously presented in an easily understandable and accessible way. While a single screen can display information from multiple sources, too much information on one screen can be confusing and overwhelming for those who must quickly absorb and act on it.

Performing usability tests with the video system operators helps to establish the optimal number of displays for the available video and information feeds, and the tasks that must be executed.

Available Budget and Cost of Displays

The cost of the video displays should be considered relative to the cost of the other systems on the platform and the overall platform costs. It most likely will not make sense to invest a disproportionate amount of your budget in video displays. As a result, you may need to make trade-offs between the amount of information that can be simultaneously viewed, and the number of displays you can afford to purchase.

Available Space

The amount of available space and location on the platform can also limit the number and size of video displays. For example, space constraints in cramped cockpits may limit you to only a single display, or force you to install multiple smaller displays rather than a single, larger display.

As well, video displays must be installed where operators can comfortably and accurately see the information on the screen, even while the vehicle is in motion. You also need to consider the interior space consumed by the communications and control systems that enable people to act on the information provided on the display.

Weight and Power Implications

Heavy and power-hungry video displays can have extremely negative effects on overall mission success. As a result, these requirements must be considered in the context of the other individual weight and power loads on the platform as well as the overall platform weight and power loads.

For example, the overall weight of the aircraft when taking off with a full fuel load and full payload and the effects on aircraft range must be considered. Similarly, in ground vehicles, the effect of the video system weight on vehicle acceleration, maximum speed, mileage, and range must be considered.

Low power requirements are important on every platform, but especially in those with a limited onboard power supply. In these situations, a video display that consumes significant amounts of power can compromise operation of other in-vehicle systems.

Level of Ruggedness Required

The video display ruggedness level required depends on the platform and the locations it will travel. For example, video displays in armored military vehicles must be able to reliably perform even when the platform is moving quickly over rough terrain in extreme temperatures. Similarly, video displays on sea-based platforms must be resilient to water and salt in the air.

When evaluating ruggedness levels, consider factors, such as

- the overall ruggedness of the display packaging and operational controls
- electronics reliability levels
- resistance to dirt, moisture, and other contaminants
- glass quality and bonding type used

Interoperability Requirements

As more systems are added to vehicles, the need for interoperability increases. For tactical reasons, video displays may need to accept inputs from intelligence, surveillance, and reconnaissance (ISR) systems, computers, switches, recorders, sensors, and other equipment on the platform.

Video displays that allow you to use a single, consistent set of cables, protocols, and software to interconnect these systems simplify installation, troubleshooting, and maintenance requirements. They also reduce SWaP and costs.

Expected Lifespan

Many deployed systems are expected to reliably operate in the field for 20 plus years. Over this time, technology will continue to evolve. As a result, it is important to determine whether the video display solution is designed to smoothly evolve and support new technologies and capabilities over time without needing to be replaced.

The Pros and Cons of Smart Displays and Simple Displays

Once all of the video display requirements and restrictions are identified and evaluated, it is time to compare the advantages and disadvantages of smart displays with on board processing technology and displays without. Here is a brief look at the primary categories of comparison.

Cost

Because smart displays include computer processing capabilities, they're considerably more expensive than simple displays. In many cases, a smart display costs twice as much as a simple display. Even when the cost of a standalone computer processing component is added to a simple display, it is still typically less expensive than a smart display. And that advantage increases over time.

The advantage is due to the fact that computer processing capabilities are less expensive when they're purchased on their own rather than as part of a smart display. In addition, when purchased separately, the computer processing component can be customized for the specific platform and application to ensure you're not paying for unnecessary processing power. Also, one computer processing component can be integrated in a platform with multiple simple displays and configured to provide different views to each distributed display eliminating the need for multiple smart displays to be installed.

As time goes by, you can upgrade the computer processing capabilities without upgrading the display, helping to minimize ongoing costs. With smart displays, it is far more likely you will need to replace the entire expensive system long before the screen needs to be upgraded.

SWaP

The computer electronics at the back of smart displays make these units heavier and deeper than simple displays. Smart displays also have higher power requirements than simple displays. When multiple displays are needed, each of these factors multiplies, even if the additional computer processing is not utilized or even needed. And there's no ability to relocate the computing component to a less crowded, or cooler, location on the platform.

On the other hand, distributing computer processing across multiple smart displays eliminates the need for a higher power server that provides images and data to simple displays. To distribute the power burden when using simple displays, multiple lower power servers can be used.

Reliability and Thermal Management

The complex electronics behind smart displays increase the risk of breakdowns. Those risks further increase when you consider the additional heat those electronics generate compared to simple displays. While smart displays do include cooling mechanisms, these mechanisms add to the cost of the display and consume additional space in critical platform locations.

In contrast, a distributed system based on simple displays naturally distributes heat. Heat-generating computers can be located away from displays, freeing up space and reducing the likelihood that electronics will overheat in the extremely cramped areas within the platform.

However, smart displays do minimize the number of power supply units (PSUs) that are required, which can improve the overall reliability of the system.

Flexibility

With simple displays, there is far more ability to choose among different display sizes and resolutions, and to take advantage of touch screen technologies. Simple displays also introduce the opportunity to choose the optimal processing technology for the application, rather than simply relying on the technology in the smart display.

In terms of architectural flexibility, simple displays provide the ability to install computing components in different platform locations, while smart displays offer the potential to deploy a client/server architecture.

Upgrades and Maintenance

With simple displays, the computer technology can be easily upgraded when the time is right with no need to replace the display. The system can also be easily expanded with additional screens and the latest computing capabilities as new technologies emerge. With smart displays, upgrades and expansion are far more complicated and potentially costly. For example, the unit likely has to be removed from the platform, opened so that individual components can be replaced, then reinstalled.

Including the computing electronics at the back of smart displays also makes it physically and logistically difficult to troubleshoot any issues with the computer processor.

Lifespan

Together, the factors described above, particularly reliability, thermal management, maintenance, and upgrades, mean a standalone, simple display has a longer lifespan than a smart display.

If the glass in a simple display is treated with respect, the display can reliably operate in the field for 20 to 30 years. Because computing technologies evolve far more quickly than display technologies, smart displays typically have a much shorter lifespan. It becomes too physically difficult, technically infeasible, or financially imprudent to continually upgrade the computer processing components in the rear of the display.

Leveraging Advanced Video Technologies for a Tactical Advantage

Curtiss-Wright recognizes that every program, platform, and application has unique requirements and constraints for video displays and computer processing. As a result, we take a building block approach, providing a wide range of standalone mission displays and modular mission computers that can be combined in the optimal configuration for the platform, tasks, available space, and budget. These flexible, COTS-based solutions are pre-qualified to military ruggedization standards and designed to simplify interoperability between legacy and new video equipment to reduce time to market, risks, and costs.

Our high-definition mission displays are designed for use with the industry's most popular sensors, including forward-looking infrared cameras and long-range daylight video cameras. They are available in a variety of sizes, provide the connectivity and I/O required to interface with the other elements in the video management system (VMS), and are readable in all light conditions.

To complement our mission displays, we offer a family of small form factor, modular mission computers. These ruggedized, highly reliable computing subsystems provide extremely high-performance image and data processing and are pre-qualified to MIL-STD levels. For example, the Parvus DuraCOR 80-41, the lightest, highest performance offering in the family, is field-proven to pair perfectly with our ruggedized mission displays in a fully standards-compliant, integrated computing and video solution for ground vehicles.

Figure 4: Parvus DuraCOR 80-41 mission computer

Figure 5: Advanced Video Display Unit (AVDU)

Advanced Video Display Units (AVDUs) are high-resolution, ruggedized LCD touch screen displays that provide the video inputs, on-screen VMS controls, and built-in quad-view and picture-in-picture functionality that's needed in large video systems.

Figure 6: Single Video Display Unit (SVDU)

Single Video Display Units (SVDUs) are ideal for medium-sized video system applications and for direct connection to computer systems that only require a single input and no additional processing.

Figure 7: Ground Vehicle Display Unit (GVDU)

Ground Vehicle Display Units (GVDUs) are ruggedized touch screen displays designed for the unique requirements of ground vehicles, where there is less light, more sand and water in the air, and greater need to operate the display while wearing gloves.

Figure 8: Ground Vehicle Display Unit (GVDU)

Rugged Video Display Units (RVDUs) are SWaP optimized rugged displays designed for non-mission critical applications such as vehicle reversing and equipment monitoring.

Curtiss-Wright also offers pre-integrated and pre-qualified systems and mission computers based on specific customer and programme requirements. Our expert system specialists leveraging decades of experience address any system integration needs dramatically reducing scheduling risks and programme management overheads. The bespoke systems or computers can then be coupled with our COTS video management and display components to address any mission specific need. Infographic: Take the risk out of integration with packaged COTS (PCOTS).

For maximum flexibility, our mission displays and mission computers are available as standalone units, or as part of a fully integrated VMS that includes our ruggedized video distribution systems and video recorders.

Together, these video solutions and systems demonstrate our commitment to helping teams in the field leverage advanced, highly reliable video technologies in a cost-effective way. And, they are another example of why Curtiss-Wright has been a trusted, proven leader in defense and aerospace for decades.

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