TECHNOLOGY WHITE PAPER

# Reducing Complex Integration Efforts with SWAP-C Optimized Video Switching

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DEFENSE SOLUTIONS

**Read About**

Video switching

Different video formats

Reducing system complexity

Low SWaP design

## Introduction

Many platforms need complex video solutions. A growing challenge for system integrators is how to get the most effective use out of the proliferating number of cameras being deployed without using too much space and adding significant weight. This white paper discusses how small form factor Video Management Solutions allow system designers to quickly and easily route the platform's video sources exactly where they best benefit users without overloading the platform.

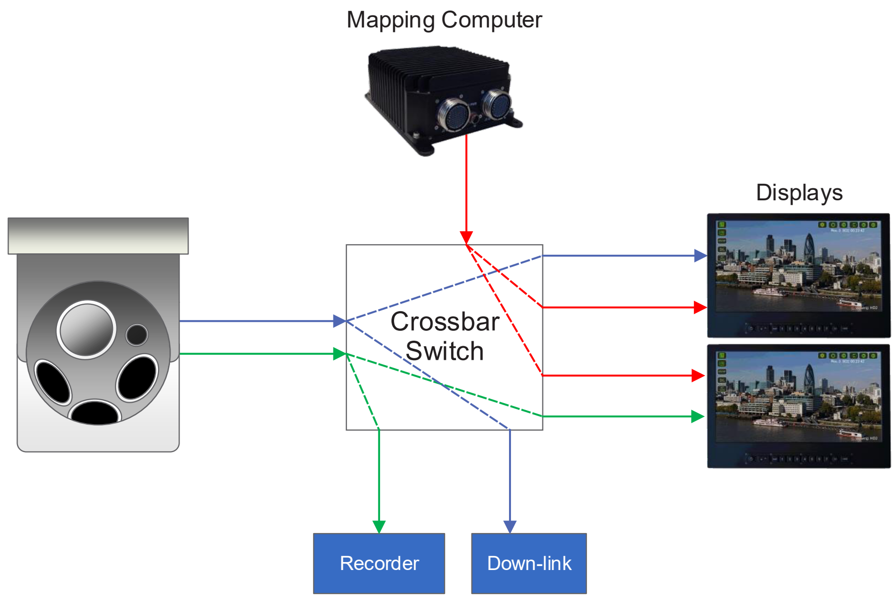


Figure 1: Video sources typically send data to multiple destinations

## Complex Video Requirements

Video systems are becoming ever more widely deployed across the full range of platforms, from small ground vehicles through to main battle tanks, to rotary and fixed wing aircraft and on to UAVs of all sizes. However, the need to conserve space, weight and keep costs down can limit their practical implementation. With the increasing tempo of deployment, multiple video formats and being able to meet new configuration requirements rapidly, off the shelf products are becoming increasingly important.


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There are several ways to connect video producers, such as cameras or computers and consumers of video for example displays or recorders or indeed image processing computers. The most common and established method is raw video which offers the truest reproduction and lowest latency.

More recently, video over IP (internet protocol) using fibre or copper Ethernet has become more popular – either uncompressed (e.g. GigE Vision) or compressed (e.g. H.264). This trend is expected to continue as 10 Gb Ethernet drops in price as it inevitably will.

However, there remains many application areas where native video will continue to be the distribution format of choice. This is true, for example, where the application does not warrant the overhead of an Ethernet infrastructure.

A common requirement across many vehicles is the need for equipment to occupy as little space as possible and in the current, and likely future financial climate, low cost is also a significant concern.

# Modern Video Systems

There are many different analog video formats still in use. These include the various composite NTSC and PAL formats through component video such as the STANAG-3350 family to computer-related formats using RGBHV.

In recent times, digital formats such as SDI (Serial Digital Interface) – standardized by SMPTE in its various formats which started life in the broadcast video industry – has become widely deployed. This is due to its relatively lightweight 75 ohm coaxial cable and its use as an output format from surveillance and reconnaissance camera products from vendors such as L3-Wescam and FLIR.

Focusing mainly on manned platforms, the video from the sensors (i.e. visible or infrared cameras) is typically fed to one or more observers and possibly to a video recorder. In the case of airborne platforms, the video is generally passed to a downlink and possibly the pilot as well. Often there is a mission computer that must be integrated; a common function is that of a moving map with Geographic Information System (GIS) overlays to provide location information. A diagram of a simplified example system is shown in Figure 1.

There are several functions required in the simple system shown in Figure 1:

- Fan-out – the video from one source is sent to multiple destinations
- Switching – a single destination may receive video from more than different sources
- Dynamic control – the allocation of an input to an output can be changed at any time

A crossbar switch has the capability to independently connect any output to any input, this allows the Infra-Red (IR) feed from the camera to be fed to one, all or none of the displays whilst the visible output from the camera is sent to the recorder and any of the displays.

In this simple arrangement, the selection for the displays would typically be under control of the operator, perhaps via buttons arrayed around the periphery of the display. This requires compatible displays that are able to communicate with the crossbar switch, for example over CANbus or RS-422 interface.

The simple system in Figure 1 includes displays with more than one video input. Whilst for simple surveillance tasks a single switched image on the display may be sufficient, to improve efficiency in more complex applications there can be a need for a display that can show images from multiple sources simultaneously. An example of this might be the camera feed in the main image and a map in a picture-in-picture (PIP) window. The display would typically be able to switch sources between the main image and the PIP window, thus there are implicit switches in the systems as well as explicit switches.

## More complex reality

As with many systems “the devil is in the detail” and such uncomplicated systems are rare. One complication is that video outputs from mission computers tend to follow PC technology and may be RGBHV (VGA) which is an analog video format. If the camera outputs are a digital format such as SMPTE-292M (HD-SDI) then the computer video either needs to be converted to HD-SDI to be fed into the same crossbar switch or for there to be a separate analog crossbar switch. Both are reasonable approaches – the latter requires displays that can accept RGBHV video as well as HD-SDI video.

Integrating computer systems video output into video switch matrices brings additional complexity. VGA and DVI interfaces support Display Data Channel (DDC) interfaces that allow displays to advertise EDID to the attached computer. EDID contains the different display resolutions supported by the display so that the computer (or user) can select the most appropriate one. In a switched system there may not be a display attached when the computer enumerates the attached display. Similarly, in a system with two different monitors - which DDC interface should be connected to the computer? Such minor integration issues often lead to a proliferation of adaptors and custom interfaces.

Having defined the functionality required in a surveillance system, implementing it within the space and budget constraints can be a significant hurdle. Smaller helicopters in particular have significant space constraints and a large central switch can be difficult to accommodate at the front of the aircraft where the displays and sensor are positioned. This leads to increases in the cable-length required as the video is tracked from the front of the vehicle to the video management system at the rear of the vehicle. The result is additional weight and space for cabling in an already space-constrained environment. The corollary to all this extra cable and weight is increased cost – both at installation, during operation and maintenance.

## The Panacea for Low SWAP-C Solutions

The ideal components of a video management system would be composed of standardized elements that can be “mixed and matched” to meet any set of requirements. These elements would be physically small and lightweight allowing them to be fitted into available spaces.

Similarly, such a solution would consist of a family of compatible devices that can be integrated together, not just switches but complex displays with integrated PIP, PBP and quad capability and video recorders. First, the components of a video management system need to be designed from the ground up for use in an airborne or military environment, demonstrably so, with supporting qualification evidence. They also need to be fit for purpose – they need to address the corner cases of the functionality envelope to create a consistent whole.

Creating the ideal product family that meets 100% of system requirements is a practical impossibility. Vendors will more typically provide off the shelf solutions to 80% of the market. This is no comfort if your application is one of “The 20%”. Selecting a vendor with a portfolio of products who is capable of modifying standard product to create modified COTS (MCOTS) can go a long way to meeting program needs.

## Rugged Video Gateways

Curtiss-Wright has created the Rugged Video Gateway (RVG) family to address these issues. It is ideal for small and medium sized video management systems as it uses scalable, low SWAP-C building blocks. The RVG-SD1 (shown in Figure 2) is a digital video crossbar switch, supporting eight SDI interfaces up to 3G-SDI (SMPTE424M), each interface can be configured as an input or output providing maximum flexibility.

Figure 2: The RVG-SD1 – an eight-port digital video crossbar switch

The RVG-SA1 is a complementary analog video switch supporting resolutions up to 1920x1080 with a 350 MHz analog bandwidth. The RVG-SA1 supports 16 analog crossbar channels, optionally arranged as separate composite channels or grouped in triples for RGsB and RGBHV. The latter is supported by the integrated horizontal and vertical sync switch matrix to support computer “VGA” interfaces. To further support the use of computer video outputs the RVG-SA1 includes four “EDID” emulators – these are permanently available for connection to computer video interfaces to provide a consistent and deterministic set of EDID information.

The whole RVG family shares the same design heritage of rugged, reliable product design, fully qualified to DO-160, for operation in 28 VDC systems. All family members support the same CANbus and RS-422 interfaces for seamless integration with supporting products.

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The family members are designed to be scalable to help support “The 20%”, the individual components can be stacked (sharing a single PSU) to create a monolithic system or distributed around the vehicle as space permits.

Curtiss-Wright also has a family of high-visibility displays, equipped with rugged resistive touch screens supporting “hard” bezel buttons and “soft” touchscreen buttons – all designed to integrate with the RVG family. By themselves, the AVDU range of displays with eight video inputs and advanced windowing capabilities (including scaling, flexible positioning, dual, triple and quad simultaneous windows etc.) could implement a simple video management system.

For recording, the VRDV7000 is a rugged, dual channel video recorder that can be controlled from the display products mentioned above.

## Summary

Video switching is just one part of the video management jigsaw puzzle, implementing it quickly in a SWAP-C constrained environment is a challenge. The Curtiss-Wright Rugged Video Gateway (RVG) family is a scalable low SWAP-C solution that is well integrated with the other components necessary for a modern video management system. Looking forward, the RVG family will be further enhanced with a video format converter to handle the conversion between different video formats, both analog and digital.

## Learn More

White Paper: Combining Multiple Video Sources into a Single Screen

Products:

- RVG-SA1: Analog Video Switch
- RVG-SD1: Digital Video Switch
- AVDU Displays: LCD Mission Displays
- SVDU Displays: Rugged Mission Displays
- VRDV7000: Dual Channel HD Video Recorder