A MORE MODERN VIEW OF FLIGHT DECK OPERATIONS

Our Mosarc™ Advanced Graphics Framework helps make flight deck operations easier, faster and safer

Collins Aerospace
An RTX Business

INTRODUCTION

Mosarc™ is Collins' next-generation, modular, open system approach to avionics. Mosarc leverages modern open system technologies, standards, tools and processes to serve market needs across both commercial and defense programs for current and future fleets. The primary objective of Mosarc is to enable rapid, seamless integration of mission avionics and safe management of flight-critical systems, all while offering maximum interoperability with products both from Collins and external vendors.

To support these needs for both civil and military platforms, Collins Aerospace developed the hardware-agnostic Mosarc Advanced Graphics Framework (AGF) that permits high-velocity upgradeability of cockpits across a range of platforms.

HOW DO GRAPHICAL USER INTERFACES (GUIs) TYPICALLY WORK?

To better understand the capabilities of the Mosarc AGF, consider how graphical user interfaces (GUIs) are created and managed for consumer electronics, such as desktop computers, tablets and mobile devices.

On these platforms, modern operating systems provide a collection of libraries, frameworks and application programming interfaces (APIs) that enable third-party developers to perform standard tasks, such as drawing on the screen and handling user inputs. This core functionality – often called a windowing system – manages utilities like windows, menus, icons and pointer interactions.

As certain use cases are common for many third-party applications, the windowing system abstracts away lower-level details like building menus, interpreting user gestures and handling hardware-specific requirements. In this way, GUI application developers are empowered to focus primarily on higher-level algorithms and application software instead of worrying about more routine user interactions.

In summary, GUI frameworks drive re-use that improves overall quality and reduces time-to-market.

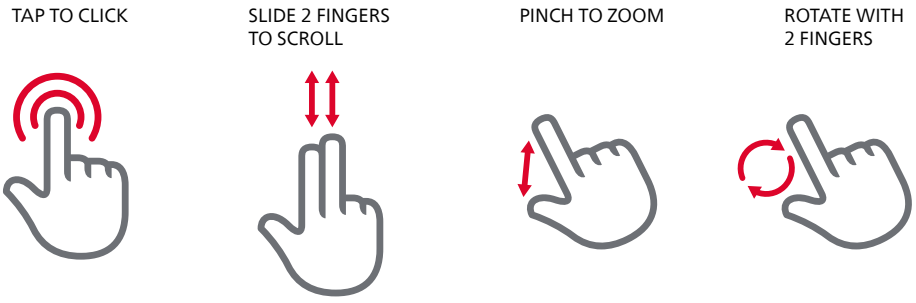


Figure 2 – Touchscreen interfaces (via their gesture engines) must interpret various user interactions.

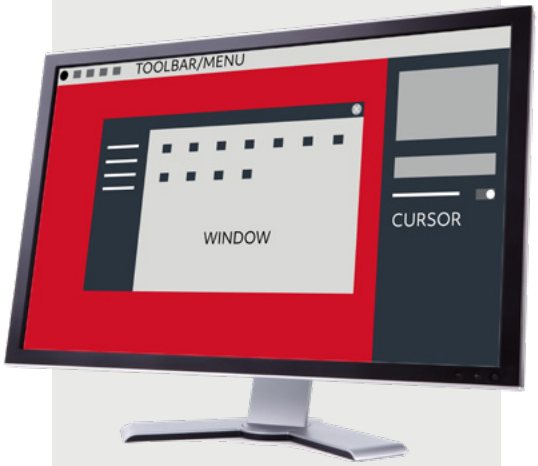


Figure 1 – A windowing system helps developers create and manage various fundamental building blocks like windows, menus and cursor interactions that are required for user control.

APPLICATION PROGRAMMING INTERFACE (API):

A documented way for two or more computer programs to communicate with each other using a set of common definitions.

LIBRARIES:

Collections of reusable software that performs specific, well-defined operations. These "blocks" can be called directly by third-party applications via APIs.

FRAMEWORK:

A software skeleton that helps application developers quickly develop their concepts by providing a starting architecture with "fill in the blanks" to enable customization. Frameworks may also include libraries and support tools.

A MODULAR ADVANCED GRAPHICS FRAMEWORK (AGF) FOR SAFETY-CRITICAL FLIGHT DECKS

Collins developed the Mosarc AGF as modular and scalable services to support the unique, safety-critical demands of crewed airborne platforms that cannot be satisfied by regular consumer-electronics GUI frameworks.

CORE FOUNDATIONAL SERVICES

The AGF provides foundational capabilities that support common flight deck application use cases. These services provide the building blocks to create an open graphical display system.

- **Display Server:** Receives ARINC 661 data or video and renders the content within specific, user-defined windows. Leverages user intent information and pre-defined configurations to provide a holistic pilot-vehicle interface (PVI).
- **Window Managers:** Enable developers to style custom user interfaces, update menus and modify window layouts, sizes and layering for different modes of operation via simple configuration files. An API allows developer applications to change display states during flight phases – supporting adaptive behavior and context awareness.
- **Flexible Interface Device Server:** Permits cursor control using a collection of input methods, such as bezel keys, knobs, keyboards and joysticks. Since peripheral-specifics are isolated from the user intent, the software architecture is extendible to future human-machine, multi-modal interfaces.
- **Gesture Engine:** Interprets user interactions like tap, press & hold, flick, drag, pinch & scale and rotate for multiple finger combinations. Just like on tablet computers, gesture support enables a richer set of commands to accelerate system interactions.

Figure 3 – Configuration files make it easy to flexibly change the application layout of the flight deck to accommodate multiple use cases. These examples show two possible "personalities" for the same large area display (LAD).

MODULAR OPEN SYSTEMS APPROACH (MOSA)

Many current cockpit GUI systems cannot be severed from their underlying computing and displays hardware. Furthermore, any software customizations to these systems, such as minor user experience (UX)/user input (UI) adjustments, often must flow through the original suppliers of these solutions.

The extendible, microservice-based Mosarc AGF includes modularity and openness at its core through its compatibility with multiple computing platforms, user peripheral devices and display sizes. Built using open, commercial standards and formats like ARINC 661, ARINC 653, Protocol Buffers (protobuf) and Javascript Object Notation (JSON), developers can select features of their choosing and add or modify display content without direct support from Collins.

Natively using model-based (SysML) artifacts and a cutting-edge certification-focused DevSecOps pipeline, AGF developers can rapidly innovate and deploy new flight deck solutions for both legacy and next-generation platforms at the speed of relevance.

ENHANCED SAFETY AND RESILIENCY

To satisfy airworthiness regulations, all components of monolithic software applications must be designed to the highest required design assurance level (DAL). Since many current cockpit GUI systems are not modular, even very minor adjustments or software additions can result in expensive and time-consulting verification and validation (V&V) activities.

The Mosarc AGF breaks this mold via its segregated, microservice-based architecture that permits components to be cost-effectively updated over time. Furthermore, the inclusion of hardened barriers to isolate faults and reversionary modes to respond to failure conditions permit the integration of mixed-DAL components within the DO-178C DAL A framework – which may include lower-DAL video inputs and user interaction devices.

RAPIDLY DELIVER NEW CAPABILITIES WITH THE MOSARC AGF

To demonstrate how the Mosarc AGF enables high-velocity deployment of flight deck solutions, consider the integration process for a new, autonomy-enabled pilot digital assistant.

In a typical workflow, accommodating this new capability will most likely require multiple changes by the original flight deck developer to the underlying display software (Figure 4, right). Not only will the requester potentially incur large expenses for these modifications, but the required updates may result in extensive delays and introduce new failure modes.

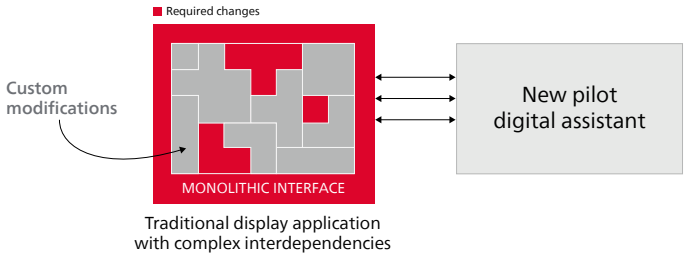
Since this baseline approach is not feasible for deploying cutting-edge technologies at scale, the Mosarc AGF provides an agile, MOSA-aligned workflow to enable rapid-iteration directly by the end user without external dependencies (Figure 4, right).

Flight deck integrators are provided a combination of open APIs and plain-text configuration files to quickly incorporate new applications using their own development teams and tools. This paradigm shift in workflow permits cost-effective experimentation, stronger intellectual property protection, and faster cultivation of new technologies.

Additionally, the microservice-based architecture reduces the certification impacts of scenario or platform-based customizations – such as UX/UI modifications to ease pilot workload – and enables the integration of mixed-DAL components. In the use case described, the platform may allow a lower-DAL process for the pilot digital assistant even though the AGF itself is designed to DAL A.

This may result in substantial lifecycle cost savings since DO-178C benchmarks show that developing software at lower-DALs can be 50% less expensive compared to the same functionality at higher DAL.

BASELINE INTEGRATION PROCESS



MOSA-ALIGNED AGF WORKFLOW

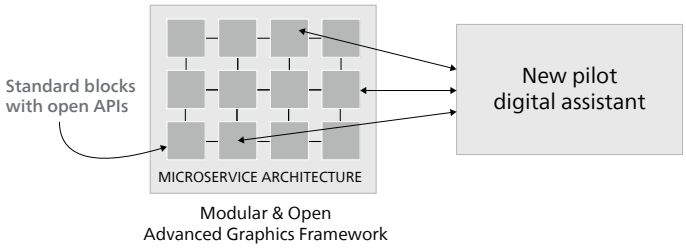


Figure 4 – Integrating new applications using traditional graphics display products typically requires custom development by the original developer. The Collins AGF enables a new development workflow via its inherently open and modular architecture.

NATIVELY READY FOR DIGITAL ACQUISITION

Complementing its modular and open architecture, the Mosarc AGF is enhanced with digital engineering and agile software development techniques. Model-based artifacts created with SysML provide the authoritative source of truth (ASoT) that can be directly integrated into your reference architectures and form the basis for a digital thread.

When applying a digitally-native workflow, unprecedented levels of dexterity can be achieved in building, testing, fielding and sustaining your systems across their lifecycles. Adjustments made within the model will be automatically analyzed and propagated to a collection of autogenerated artifacts.

Compared to traditional approaches, benchmarks have shown about a 5x improvement in test execution efficiency to accompany the even greater cost reductions and risk avoidance achieved through early error detection.

5x

improvement in test execution efficiency

THE MOSARC DIGITAL WORKFLOW

Combines model-based systems engineering (MBSE), virtual integration and a certification-focused DevSecOps pipeline with a collection of continuously improving management and analysis capabilities

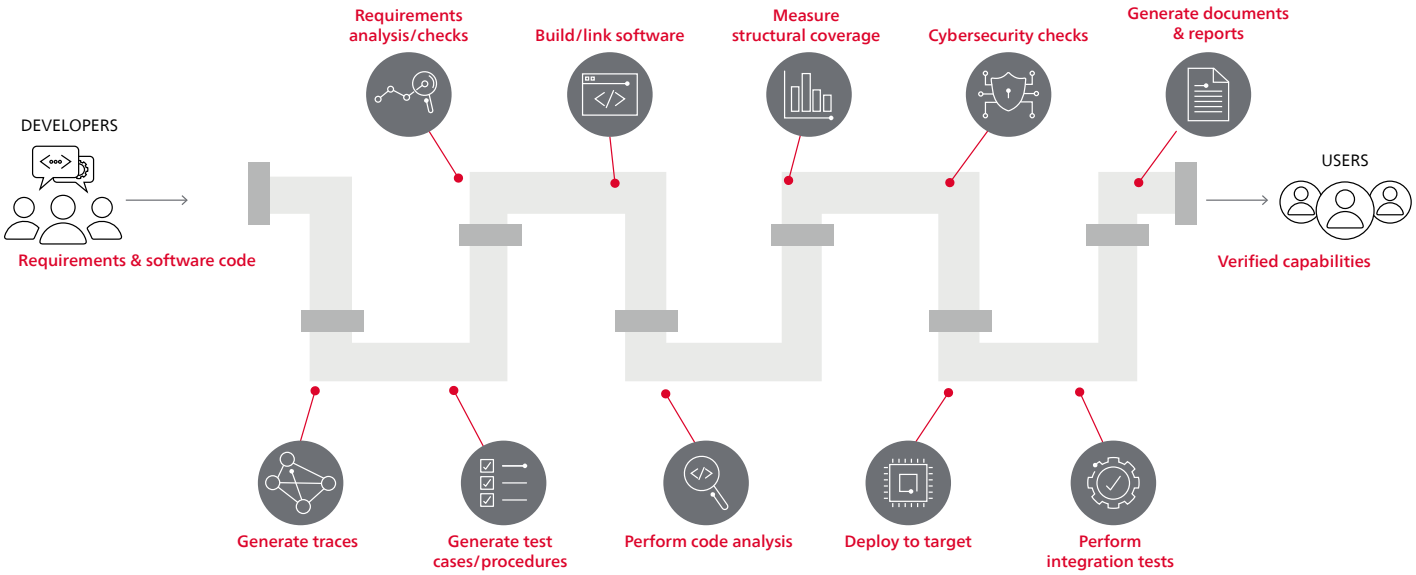


Figure 5 – Flight deck integrators are provided a combination of open APIs and plain-text configuration files to quickly incorporate new applications using their own development teams and tools.

NEXT STEPS

For Mosarc AGF and other applications, Collins can also support your adoption of more digital processes by providing tools, services, infrastructure and expertise. As this is a rapidly-evolving domain with many specialties, Collins is uniquely positioned to reach across our broad collection of civil and military portfolios to offer world-class capabilities on a variety of topics: model-based systems engineering (MBSE), trusted methods, cybersecurity analyses, certification-focused DevSecOps, virtual integration, digital twins and modeling and simulation (M&S) of platform systems down to semiconductors.

Collins Aerospace and our Mosarc Advanced Graphics Framework (AGF) can support your adoption of modular and open graphics solutions on both next-generation and legacy platforms. We can offer new ways to achieve unprecedented levels of agility and resiliency in delivering new flight deck capabilities.

To learn more about the Mosarc AGF or our other technologies, contact Collins Aerospace at mosarc@collins.com.

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