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**MODULAR AVIONICS SOLUTIONS**

# OUR MICROSERVICES AND CONTAINER SOLUTIONS ENABLE A MODULAR, OPEN SYSTEMS APPROACH

**Multi-vendor integration capabilities save time and money**

Collins Aerospace

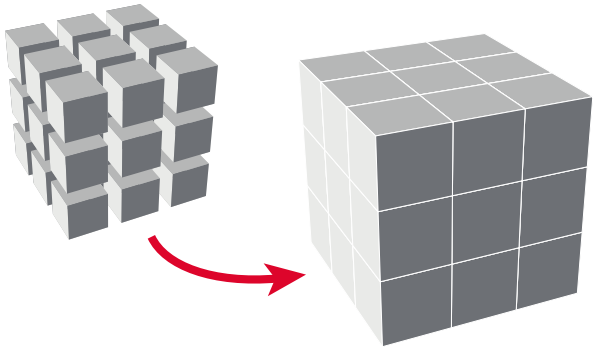
# INTRODUCTION

Rapidly fielding technical capabilities at the speed of relevance requires new approaches to development. Microservices and containers – two complementary software technologies – have enabled Big Tech companies to achieve unprecedented levels of agility, redundancy and security in their information technology (IT) infrastructure.

Collins Aerospace is now bringing these same capabilities to airborne applications via our Containerized Application Platform System (CAPS). But before we get into how CAPS works, let's define our terms.

## What do we mean by microservices and containers?

Microservices and containers provide core infrastructure needed to assemble large software applications from smaller, independent, multi-vendor building blocks. They support a modular open systems approach (MOSA) and leverage open-source tools, frameworks and software to reduce costs and delivery times.



*Modular building blocks make it easier to rapidly deliver advanced capabilities.*

### MICROSERVICES:

Independently deployable software components focused in one domain that communicate over open application programming interfaces (APIs). System architectures that leverage microservices prefer smaller, loosely coupled software elements over complex, monolithic applications.

### CONTAINERS:

Smaller and more agile than virtual machines (VMs), containers bundle up the software application with all its dependencies (such as required configuration files, libraries and supporting utilities) to isolate the software from the hardware environment. The result is a single image that runs identically on development computers, in a DevSecOps pipeline or on platform hardware.

# THE AVIONICS ADVANTAGE

## While there are upsides to using microservices or containers individually, their benefits are maximized when combined.

For avionics systems in particular, architectures leveraging containerized microservices have several key advantages over traditional applications and development approaches:

### CREATION OF MODULAR SOFTWARE BUILDING BLOCKS

Open interfaces over industry-standard protocols isolate intellectual property (IP) concerns and support a mix-and-match approach to procuring capabilities from multiple vendors. Fast-moving technologies, such as more autonomous systems, can be integrated over time with minimal impact to the existing collection of components.

### REDUCTIONS IN NON-RECURRING ENGINEERING (NRE) COSTS

Changes to large, legacy applications can be prohibitively expensive due to complicated interdependencies. It may pay off to refactor the software code for the legacy application into microservices.

### INCREASED RELIABILITY WITH LOWER SWAP-C

Container isolation helps protect the host computer and other applications from erroneous operations. Multiple instances of containerized microservices can be cloned across computing platforms to enhance reliability and more effectively use existing processing resources – potentially lowering system size, weight, power and cost.

### INTEGRATION OF MIXED-CRITICALITY COMPONENTS

Containers enable a collection of microservices to be developed with multiple programming languages or have varying levels of criticality. Existing components with higher design assurance levels (DAL) can be isolated from rapidly changing ones with lower DALs – reducing re-certification costs.

Elaborating on the last point, higher-DAL elements limit the pace-of-development and raise costs by burdening all subsystems with safety-critical hardware, operating systems, tools and review processes. Creating lower-DAL enclaves using containerized microservices enables the lower-criticality components of these systems to benefit from open-source software and agile development techniques.

# CONTAINERIZED APPLICATION PLATFORM SYSTEM (CAPS)

Most open-source technologies used to enable containerized microservices were originally created for ground-based IT applications within data centers, where nearly infinite computing expansion is possible. And the larger the quantity of software containers, the more oversight and management techniques are needed to eliminate manual setup and maintenance tasks. The automated process of managing the deployment, scaling and networking of multiple containerized microservices is referred to as orchestration.

To bring the benefits of containers and container orchestration to resource-constrained airborne platforms, Collins Aerospace developed CAPS.

**CAPS is a collection of Collins-developed microservices that configure and extend commercially available, open-source, cloud-native applications for the constrained resources of the airborne environment.**

Based on an easy-to-use, mainstream technology stack, CAPS ensures reliable operations for a collection of containerized microservices in an embedded avionics environment where power is pulled after each flight and the system is never connected to an IT network for maintenance.

## CORE FOUNDATIONAL SERVICES

CAPS includes open APIs to allow multi-vendor programs to monitor status and initiate activities such as installation, removal or upgrades to applications. Simplified management functions like routine maintenance, integrity checking, hardware reconfiguration and sensitive data control are included – allowing for rapid continuous style delivery and evaluation of software features on specific aircraft or missions.

## RESOURCE MANAGEMENT

CAPS can assign containerized microservices to specific computers, enforce restrictions on processor and memory usage, as well as command applications to sleep or activate depending on mission needs. This ultimately results in lower SWaP-C since existing processors and computing systems are more effectively utilized.

## ENHANCED SYSTEM REDUNDANCY

CAPS improves the robustness of aviation systems by allowing containerized microservices to be cloned across multiple, physically-separated computers and automatically restarted in case of failure. This improves the overall probability of mission success and can further reduce SWaP-C through more efficient hardware utilization.

Additionally, the CAPS ecosystem supports other MOSA and digital acquisition concepts like Future Airborne Capability Environment (FACE™), DevSecOps and model-based systems engineering (MBSE).

# EVOLVING LEGACY PLATFORMS TOWARDS MODULAR OPEN SYSTEMS WITH CAPS

CAPS provides benefits to both legacy and next-generation platforms. For the former, various techniques exist to iteratively evolve legacy monolithic software infrastructure towards modular open systems.

As an example, consider a legacy Flight Management System (FMS), where new updates may prove to be prohibitively expensive due to a complicated set of interdependencies (Figure 1, Step 1). In this scenario, the FMS could be wrapped in a software application that routes certain requests to existing code (for uncompromised legacy behavior) or to new, continuously-added microservice-based functions (Figure 1, Steps 2 & 3). This routing behavior can either be permanent or dependent on configuration settings.

As time progresses, the system evolves to become a more modular and open system that can incorporate state-of-the-art technologies at an increasingly accelerated pace.

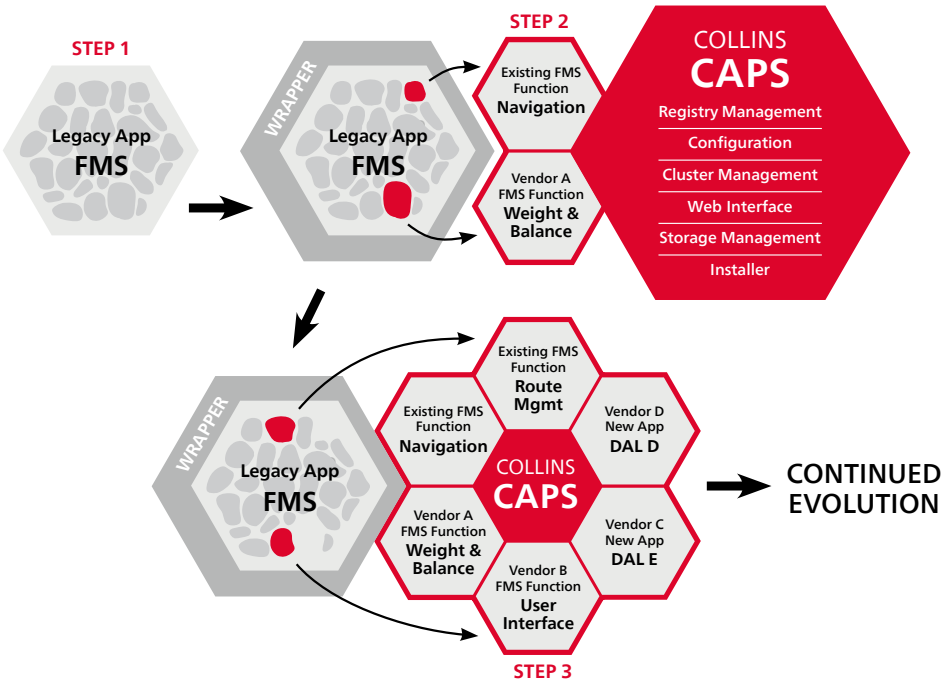



*Figure 1 – CAPS makes it easy to customize and add new technologies over time. This includes accommodations for advanced sensors, resilient navigation, enhanced pilot-vehicle interfaces (PVI), health reasoners and autonomy functions.*

## Next steps

Collins Aerospace and our CAPS technology can support your adoption of containerized microservices on both next-generation and legacy platforms. We can offer new ways to achieve unprecedented levels of agility, resiliency, and security in delivering new capabilities.

To learn more about how containerized microservices can benefit your application and support your MOSA objectives, **contact Collins Aerospace at mosarc@collins.com for a free evaluation.**

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