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Software Reuse in Avionics: A FACE™ Approach

EXECUTIVE SUMMARY

Over the last decade, U.S. military procurements have seen increased pressure for more cost-efficient, reusable and modular, standards-based applications ready for flight for both manned and unmanned missions. As a result, the industry is experiencing a shift toward open architecture standards and development designed to ensure standardization and reuse of code for applications such as avionics, ultimately aimed at lowering acquisition costs. Standards such as the Open Group Future Airborne Capability Environment (FACE™) have emerged as a progressive alternative to traditional development.

Software conformant with the FACE Technical Standard can be used—and most importantly, easily reused—by suppliers and integrators of avionics systems across different programs and aircraft. To lead the support of this innovative new technical and business model, Wind River® marched its VxWorks® 653 platform through the FACE conformance certification process to be the first FACE Technical Standard Operating Systems Segment (OSS) Safety Base Profile certified product. This achievement reaffirms the Wind River commitment to supporting the acquisition of affordable software systems that promote innovation and rapid integration of software-defined capabilities across global defense programs. This paper sets forth the challenges surrounding the transition to open architecture designs and the positive technical and business impact on the avionics industry.

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THE OPEN ARCHITECTURES CHALLENGE

Historically, airborne systems were developed for a unique set of requirements for a single manned aircraft by a single vendor. Because each aircraft was designed for a specific mission, there was not an overarching reason to have software acquisition teams support software application reuse across multiple programs and platforms. Over time this defense acquisition process gave way to long lead times, design lock-ins, and single vendor dependencies.

In a software-defined world, this historical procurement process is inadequate to support agile and globally competitive airborne capabilities. Government procurement mandates such as Better Buying Power 3.0 were created to challenge this procurement process with a focus on improving acquisition and maintenance costs for new and deployed systems. But to increase software agility, a new development and sustainment paradigm needed to be invented—this is the FACE technical architecture and business strategy.

THE FACE VISION

The vision of the FACE Consortium, a voluntary consensus standards body comprising more than 90 government and industry organizations, is to fundamentally transform the process of airborne software development, procurement, deployment, and sustainment by eliminating platform-specific, tightly coupled designs with unique and closed interfaces that inhibit cross-platform reuse and interoperability between systems. Consortium members worked together to solve the myriad technical and business challenges to transform these processes and systems, with a focus on the wide adoption of open architectures and open component interfaces by multiple services and agencies. FACE built a set of open standards for portable, capability-based applications for Department of Defense (DoD) avionics systems with the following characteristics:

- Built upon an open architecture and a common data model
- Implemented an integrated modular avionics (IMA) approach proven by the commercial aerospace industry
- Leveraged over 100 existing aerospace and defense standards
- Developed methodologies that supported components that are portable, modular, partitioned, scalable, extendable, safe, and secure

- Developed a foundation of testing and conformance to reduce integration risk and maximize interoperability between applications

As shown in Figure 1, the path to achieving this vision requires the removal of closed, proprietary components and the wide adoption of open architectures and open component interfaces.
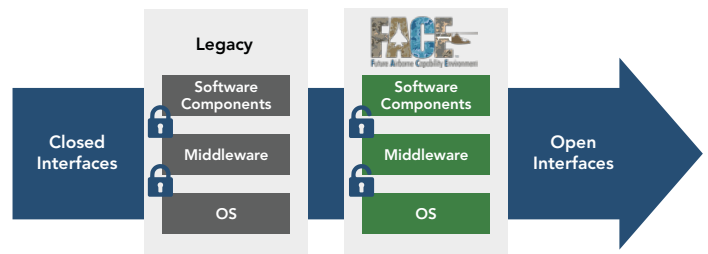

Figure 1. FACE migration to open interfaces

FACE: A STANDARD OF STANDARDS

FACE leveraged existing commercial and military standards, assembled them in an open framework, and added a fair and balanced business strategy for procurement of FACE components. To control quality and increase interoperability, the FACE Consortium also created a FACE conformance verification and certification process.

The FACE Consortium did not invent new application programming interfaces (APIs) or new platform standards—it leveraged proven, existing commercial and military standards, including:

- ARINC 653 Time and Space Partitioning Application Executive for IMA platforms
- ARINC 661-4: Cockpit Display System Interfaces
- ARINC 664: Aircraft Data Network
- ARINC 429: Digital Information Transfer System
- ARINC 739A-1: Multi-purpose Control and Display Unit (MCDU)
- POSIX®
- IETF RFC 2373: IP Version 6 Addressing Architecture
- OpenGL ES Common Profile Specification
- Canadian Trusted Computer Product Evaluation Criteria (CTCPEC)
- Department of Defense Directive 8500.1, Information Assurance
- RTCA DO-178C Software Considerations in Airborne Systems and Equipment Certification
- Trusted Computer System Evaluation Criteria (TCSEC)
- More than 100 other standards

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WHO SHOULD CARE ABOUT THE FACE APPROACH?

Any military avionics contractor to the DoD should already be familiar with FACE technical and business standards. The U.S. is the largest market for avionics, and FACE requirements have already been specified in more than 50 public government procurements with FACE requirements today (see www.opengroup.org/face/procurements).

There are also multiple nonpublic procurements from the U.S. Air Force, U.S. Army, U.S. Navy/NAVAIR, DARPA, and U.S. SOCOM with FACE requirements. So this standard is now well entrenched into U.S. military procurement operations. There are also foreign militaries that are standardizing on FACE.

FACE SOLUTIONS FROM WIND RIVER

In the FACE Technical Standard there are four FACE OSS profiles, scaling from a small, security-sensitive profile to two safety profiles to a general purpose profile, with an increasing number of POSIX calls in each profile.

Figure 2. FACE Operating Systems Profiles

The award-winning Wind River VxWorks 653 Platform was the first RTOS to achieve FACE certification conformance. VxWorks 653 2.5 was certified conformant to the FACE OSS Safety Base Profile requiring both ARINC 653 and 241 POSIX calls on March 15, 2017.

Use of VxWorks 653 by military programs enables these programs to benefit from the size, weight, and power (SWaP) and platform consolidation advantages that are proven in commercial aerospace. It is also ideal for programs with multiple IMA suppliers that need to conform to the RTCA DO-297 standard.

CONCLUSION

FACE is a global approach to enable accelerating software-defined avionics capabilities to the end user faster and at an affordable cost. The FACE business strategy addresses the business concerns that have hampered other open standards initiatives, establishing a balanced, competitive environment for both large and small software suppliers.

The FACE Standard and business strategy are being designed through industry and government collaboration, following a model for public-private partnerships relevant to many domains. The FACE Standard and conformance program are creating a new, open defense marketplace for embedded software. Successfully completing the FACE conformance certification launches a new era of rapid integration and deployment of global avionics software.

Wind River is affirming its leadership position in the marketplace of trusted, certified FACE conformant products by having the first commercial off-the-shelf (COTS) OS product to achieve this significant FACE certification milestone. This certification allows VxWorks 653 to usher in a new era of open architecture avionics for the benefit of the global avionics community.