Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2019-814

Topic # N152-096

Miniaturized, Fault Tolerant Decentralized Mission Processing Architecture for Next Generation Rotorcraft Avionics Environment

WW Technology Group

WHO

SYSCOM: NAVAIR

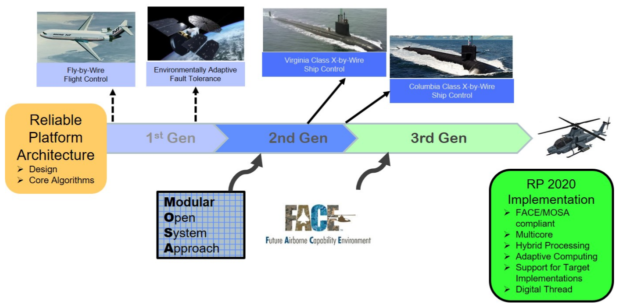
Sponsoring Program: PMA 275, PMA 276

Transition Target: V22, H-1

TPOC:
(301)342-5690

Other transition opportunities: The Reliable Platform (RP) could be transitioned to systems involving autonomy, reliability and survivability. These include military aircraft, manned/unmanned surface and undersea vehicles, satellite systems, virtual platforms, military and commercial vehicles, control systems and health monitoring systems.

Reliable Platform Concept Development



Notes: The Reliable Platform (RP) is a fault tolerant architecture that provides a structured but versatile framework for the delivery of dependable services for a mission-critical system. The approach is based on defining a structured hierarchy of critical fault tolerant services with corresponding properties that can be explicitly specified and formally verified.
The scalability and modularity of the RP architecture supports transitions to applications ranging from systems with a single to many nodes. The system framework provides an API with flexible services to gracefully adapt to changing system configurations, missions, and environments.

WHAT

Operational Need and Improvement: Avionics systems must accommodate an increasing range of processing elements, networks and peripheral devices while increasing fault tolerance and decreasing costs. The federated mission computer/processing architecture, which centralizes the aggregation of data for processing and human/machine interface/subsystem transmission, use a secondary processing computer for redundancy. Given a fault, this approach can provide reduced situational awareness (S/A) capability, which can add security and safety risks. Inflexible hardware-based fault-tolerance adds considerable costs over the system life-cycle.

Specifications Required: An affordable and customizable software-based fault-tolerance solution is needed that ensures full capability throughout a mission. The solution must be scalable and extensible to include legacy or new processing elements, networks, applications, and COTs/GOTs components. It must also be self-checking to ensure it is as reliable as the system it protects. This system should be capable of losing up to 50% of the processing nodes while maintaining full situational awareness (S/A). It should have a singular nodal processing system of at least 3 nodes with a documented expandability limit, a unit cost 20% or less of existing mission computers which cost $200 - $300K. The solution will fit into the Modular Open Systems Architecture (MOSA) and the Future Airborne Computing Environment (FACE).

Technology Developed: The technology base developed in this effort includes: (a) The Reliable Platform System Architecture for a fault tolerant system with formally proven fault tolerant algorithms, (b) a distributed software-based fault tolerant architecture implementation, (c) a design and simulation environment that includes an RP virtual machine with EDICT model-based tool support, and (d) the capabilities to perform run-time test and monitoring.

Warfighter Value: RP is built on a proven concept updated for a new generation of platforms. The approach supports insertion of the latest technology (hardware/software/networking) for the new and legacy platforms. The approach has been shown to be cost effective in programs of record. The fault tolerance delivered expands the operational space with improved dependability and coverage to the harshest categories of errors to which a system may be exposed. The system can operate at maximal dependability required for fly-by-wire applications with "never give up" strategy should massive physical damage occur.

WHEN

Contract Number: N68335-17-C-0384 **Ending on:** September 30, 2019

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Baseline Reference Architecture and Requirement Analysis	N/A	Ability to support avionic system requirements	TRL 5	January 2018
Lower Tier Reliable Platform Services	N/A	Complete concept development	TRL 4	April 2018
Upper Tier Reliable Platform Services	N/A	Complete concept development	TRL 4	August 2018
Prototype Implemention of the Fault Tolerant Architecture	N/A	Complete development	TRL 5	May 2019
Design and Simulation Environment	N/A	Complete development	TRL 5	July 2019
Demonstration and Test	Low	Successful Demonstration and Evaluation	TRL 5	September 2019

HOW

Projected Business Model: The business model envisioned is to produce a fault tolerant software product with supporting tools and service. Sales would be generated in three ways: (1) direct purchase of the software product where the customer integrates the final system, (2) Already tested system configurations that support solutions requiring medium to high levels of dependability , and (3) entering into custom design contracts and/or strategic partnerships with other companies, either to provide an enhanced distribution channel or for applications where a customer requires a highly specialized solution.

Company Objectives: WWTG's objective is to continue to be a leader in fault tolerant systems that are open, modular, scalable and readily customizable while providing state-of-the-art levels of dependability. In the near term, this project advances a fault tolerant architecture for next generation mission avionics with ready transitions to other comparable mission-critical applications. The long-term goal is to increase system robustness, scale, and affordability with state-of-the-art capabilities for distributed architectures, virtual platforms, testing, and monitoring. The insight required to achieve these objectives have also led to the development of companion technologies that offer additional paths for successful transitions.

Potential Commercial Applications: Many applications that rely on distributed real-time processing architectures for mission critical computing are moving toward increased architecture complexity. As growing reliance is placed on these systems, aspects of performance, dependability, safety and security also increase markets that require mixed critical computing architectures. Examples of these domains include avionics, automotive systems, autonomous computing, cooperative enterprise management systems, multi-vehicle maneuver/monitoring, aircraft flight control systems, power plant management, e-commerce server farms, and integrated medical systems.

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