It Takes Innovation and Company Collaborations to Isolate Complex Digital System Errors and Mixed Signal Intermittent Faults (NFF) on Mission Critical Systems

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Collaboration Introduction and Bona Fides

Ridgetop Group Facilities in Tucson, AZ

Innovative Research and Technology Firm
Incorporated in 2000, HQ in Tucson, AZ
Design services, advanced diagnostics and condition-based maintenance (CBM+)
solutions

AS9100D, DO-178 and DO-254 compliant quality systems

DragoonITCN Facilities in Dayton, OH

WOSB Technology Firm
Incorporated in 1992, HQ in Dayton, OH
Test Tool Products, Engineering services
Army SETA: ISR  AF SBIR Phase III
ISO 9001 2008

Collaboration is sharing resources for the common good with equal exposure and reward
Maintenance Impact

THIS CONCEPT DEALS WITH THE EXTENSION OF SERVICE LIFE OF KEY LEGACY PLATFORM LRUs – F/A 18 is a readily available example for demonstration

The VPM-25B is the processor in the AYK-14 LRU for the armament release for the F/A 18

This Ridgetop/DragoonITCN collaborative effort will enable the rapid return to service of circuit card assemblies that are extremely difficult to trouble-shoot. The AYK-14 Demo is currently available for inspection and review.
Problem Statement

- Conventional test program sets (TPS) are not considered adequate for all Circuit Card Assemblies (CCAs)
- Some CCAs test fine in the depot, yet fail when installed into aircraft.
- Major problems stem from “No Fault Found” (NFF), “Retest okay (RTOK)” or “Bounce Rate”
- Expanded test approaches are needed
Cost Savings

- The estimated cost-avoidance enabled by NightHawk is a conservative $2 million per year per “bad actor” Circuit Card Assembly (CCA) part number in direct maintenance costs.

- There are additional savings from reduced indirect logistic and inventory management and increased asset availability. Cost-avoidance calculations use a very conservative estimate of 100 instances of “bad actor” CCAs, each incurring an average of two unnecessary maintenance actions at a round-trip cost of $10,000 in FY2014 dollars.

The cost-avoidance for just three types of bad actor ALQ-172 CCAs over the next five years is over $30 million (3 CCA x $2M/year x 5 years). Extending the NightHawk technology to other Air Force aircraft and subsystems assets will further enhance cost-avoidance.
This effort was envisioned to reuse equipment and software developed with prior AFRL SBIR investment (to include Warner Robins CRP Sustainment Technology Transition) to prove the principal of a legacy LRU CCA troubleshooting technique.
Our Capability Improves Maintenance

- Ridgetop Group’s **NightHawk NFF Reduction Software Toolkit** is an interactive software test development platform system that will find, reduce, or eliminate NFFs on LRUs that are integrated to current weapon systems and aircraft. Originally architected through the Air Force VDATS system, NightHawk is a modular solution that is adaptable to multiple ATE such as e-CASS and other commercial ATE.

- DragoonITCN’s **C-TAC Plus** provides support for processor execution analysis through its real-time data recording and software debug operations through its interactive processor control console operations. Providing monitoring and debugging capabilities for legacy avionics systems, the C-TAC Plus support processors such as PACE-1750A, Z8001/2, i486, and other unique processors.

The benefits brought to an F/A-18 armament release system through the combination deployed test solutions of NightHawk™ ETRS and DragoonITCN's CTAC™ Plus:

- Create a portable test domain that addresses reliability signatures in embedded monitoring systems and mission critical LRU applications
- proven through integrated testing.
- NightHawk™ and CTAC+ are DoD-wide application solutions.
Quantifiable Benefits of a NightHawk/C-TAC Plus Integration

- There are many instances of future benefits that could serve rapid response platforms such as deployed UAVs and if the MIL-STD-1553 is accessed, leveraging this technology will result in powerful dividends which include:
  - Reduce diagnosis time by at least 60%.
  - Is a nonintrusive tool that connects to the system under test that costs less than $90K.
  - Predictable warranties are possible thereby achieving more value for NPV dollars spent. Conditioned Based Maintenance (CBM) is facilitated by up to 50% cost savings.
  - Potential cost avoidance enabled by NightHawk™ is conservatively estimated at $2M per year per “bad actor” CCA of direct maintenance costs using NightHawk™ on depot test systems.
  - Improve self-directed teaching and learning techniques for complex digital and mixed signal systems.

The integration of the NightHawk with C-TAC Plus would be demonstrated on an F/A-18 VPM-25B processor inside an AYK-14 LRU. The display depicts the recorded real time channel events detected on the target interface. Displayed are the time acquired, address, data value and disassembled mnemonics. A trigger has been supplied to the NightHawk for further analysis to determine failed components.
Current Maturity Status

- Initially developed for the Air Force VDATS system, NightHawk stands at TRL 7 and has been proven and demonstrated at Warner-Robins Air Logistics Complex on ALQ-172 and other CCAs.

- C-TAC Plus is a readily available, fielded TRL 9 test tool used to instrument legacy embedded systems utilizing a COTS hardware and software platform that is typically tailored to meet unique interface requirements for each specific application.

Commercial Benefits include:
- Automotive electronic boards and systems
- Telecom boards & systems, satellite TV Set Top boxes
- Industrial and commercial electronic boards and systems
- Green Energy boards & systems
- Automotive maintenance and repair applications
- UAVs
NightHawk™ Long Term Goals

- Each VDATS Test Station to have NightHawk™ software installed and available to test personnel.

- Each CTAC System (MIL-STD-1553) to have compatible NightHawk software installed.

- Port NightHawk to other test platforms such as NGATS (Army) and eCASS (Navy)

- Establish a NFF User Group to foster “best practices” and expand reduction in NFFs.
Summary

- Ridgetop and DragoonITCN will demo the concept at Government’s location of choice
- Cost Share initiated by collaborative effort and further analysis effort planned
- ROI is a HW/SW solution to a CCA maintenance issue