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Common Software Approach to Testing all Avionics Data Buses

Background:

Avionics data buses have been around since the 1970s and there are different electrical and protocol standards that have been adopted for different platforms and applications. As needs arise there are typically many different communication standards that can be used on board a commercial or military aircraft or ground vehicle and its subsystems.

MIL-STD-1553 is a bus standard that defines the electrical and functional protocol of a serial data bus. It was designed for military aircraft but has been adopted on many different types of applications including but not limited to ground vehicles, satellites, and the A350 commercial aircraft. MIL-STD-1553 was first used on the F-16. Many military aircraft since the introduction of the F-16 have adopted this bus and it has become the de facto standard that provides a reliable and deterministic data bus for many military platforms.

During this same time frame ARINC-429 was also developed. ARINC-429 is a different avionics data bus communications standard that defines the electrical and protocol for a two-wire data bus to support aircraft communications. This bus became the de facto standard for many commercial and transport

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aircraft that is still in use today. Since ARINC-429 is defined to run at only 100KBps for high speed communications the need for a higher speed on more modern-day commercial aircraft became apparent. The bus operates in such a way that a single transmitter communicates in a point to point connection with up to 20 receivers. This requires a significant amount of wiring for this slow bus communications. The industry started looking to other alternatives due to the speed and wiring issues. ARINC-664 or Avionics Full-Duplex Switched Ethernet (AFDX®) was developed as a next generation reliable and deterministic bus standard to replace ARINC-429. This bus standard is based on top of commercial Ethernet technology. AFDX is one implementation of deterministic Ethernet defined by ARINC 664 Part 7. AFDX was developed by Airbus Industries for the A380, initially to address real-time issues for flight-by-wire system development. The ARINC-664 bus was used for the first time by Boeing on the B-787 and is now being used by the B-777x aircraft. ARINC-429 was not replaced but supplemented in some parts of the aircraft to create local area networks. This in turn allowed for higher speeds where necessary and decreased overall weight of the wires.

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CANBus has been widely used by the automotive market and has been adopted alongside MIL-STD-1553 for many ground vehicle applications as well. This became a lower cost bus that is commercially available for systems that don't need the determinism of MIL-STD-1553. The commercial aviation word saw this and implemented an upper layer protocol on top of CANBus called ARINC-825. This is used in some system to system communications on board commercial aircraft.

Many of these bus protocols have a different set of suppliers which can complicate things. To make matters worse, even though each of these protocols has an electrical and protocol standard that each supplier must meet, the software programming methods can differ between each manufacturer making it even tougher to create test applications to support these platforms that use these avionics data buses.

PBA.pro Integrated Test and Simulation Platform:

AIM has created a solution to this problem by developing a framework that allows for extensive use of Python and graphical programming to handle all avionics data buses under one common interface.

PBA.pro is a graphical toolset that uses Python to standardize on a common software programming interface for multiple protocols. The PBA.pro software is Operating System agnostic with support for the two major operating systems off the shelf as Windows and Linux. Based on a modern QT architecture, PBA.pro can do much more than your basic bus analyzer needs while still providing the simplicity required to cover your simple bus troubleshooting applications. PBA.pro allows you to

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monitor and simulate avionics bus data with no programming required, saving you time and money while guaranteeing success.

The main framework provides out-of-the-box functionality for protocols such as MIL-STD-1553, MIL-STD-1760, ARINC-429, ARINC-664 or AFDX®, ARINC-629, Gigabit Ethernet, CANBus, ARINC-825, EADIN and much more making it a true universal test platform for all modern avionics databus interfaces. This truly allows you to learn one tool to cover multiple applications and platforms for test, analysis, simulation, validation and verification. PBA.pro is modular, scalable and customizable by the user to cover a wide range of applications in an extremely efficient manner. Standard common displays for each avionics databus protocol are easily accessible to monitor and simulate data via graphical menus in an intuitive hierarchical graphical format.

PBA.pro Engineering Units:

Data within PBA.pro can be viewed in raw (wire) format or in engineering units. PBA.pro has a built-in database parameter manager that will allow you to create parameters to view data (real-time) in scaled engineering units to see the real meaning of the raw data. If you have a digital format of an ICD (Interface control document) then can easily import this into PBA.pro. This helps alleviate the problem of having to convert your ICD format into a proprietary format each time. Public ICD databases (such as ARINC-429 equipment) are also available for use.

Real-time ICD import is now completely scalable and flexible to any form of existing digital data including Excel, CSV, XML, SQL, JSON and more!

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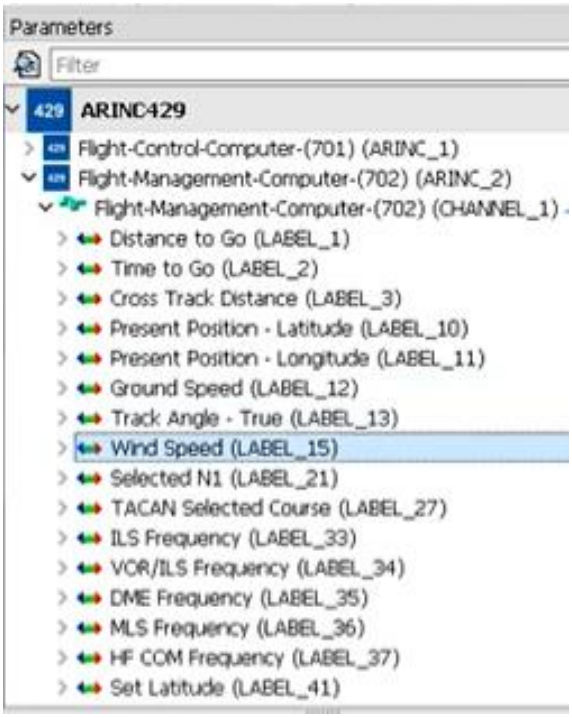

PBA.pro Designer:

The designer component allows the developer to create graphical screens with panels and gadgets for display elements or simulation elements with no programming experience simply by dragging and dropping things into panel containers. Users can now create virtual instrument panels and avionics cockpit displays in minutes by leveraging AIM's intuitive data relationship approach for any databus protocol.

A huge library of ready-to-go widgets are included with PBA.pro including avionics displays, gauges, LEDs, graphs, buttons, sliders and more.

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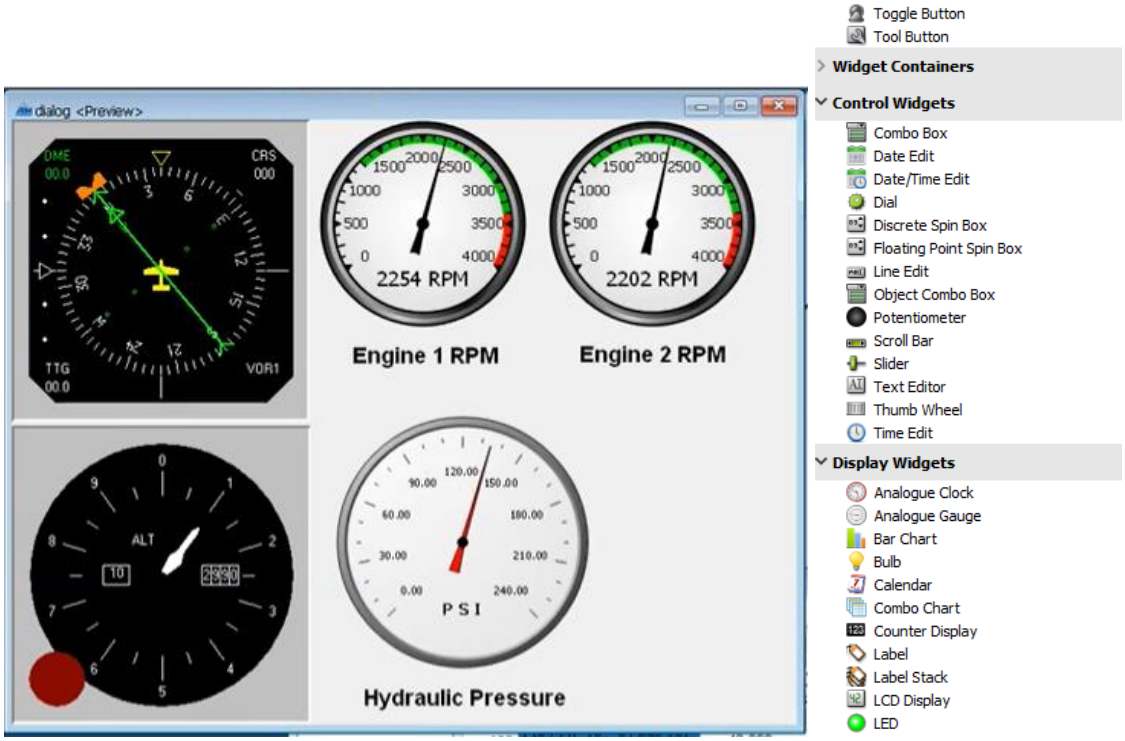

PBA.pro – Test and Scrip Manager:

PBA.pro also includes 100% automation support for Python with a built-in Python interpreter. Anything that can be done with a mouse and keyboard can be automated via Python with Python objects available for all PBA.pro components. Automation via scripting can easily save time by removing repetitive or cumbersome tasks from users. It also can run quickly reconfigure PBA.pro to different configuration on-the-fly to allow the tool to be as flexible as possible. Your entire application can be scripted via Python or you can just automate certain tasks if you wish. It is extremely easy to switch between manual and automated tasks.

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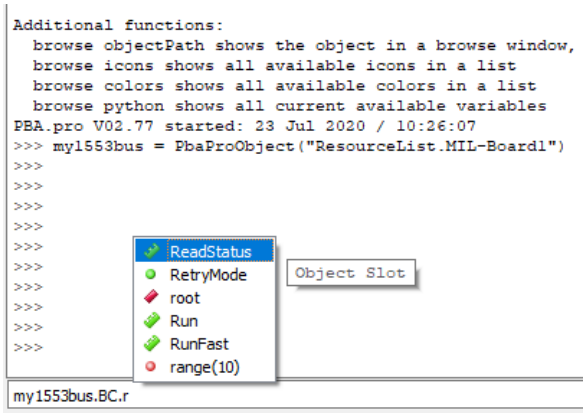

In addition to automating any procedure/setup within PBA.pro, the tool is fully extensible to any other application or process. This is done with a built-in Action Server (TCP/IP based) running within PBA.pro. Any external application can request data or communicate to PBA.pro to perform any action (e.g. Start/Stop Monitoring data).

The above gives users to power to allow PBA.pro to become part of a larger testing infrastructure and to properly offload Avionics Databus processing from other Test Executives. External control plug-ins for PBA.pro are available for C/C++/C#/.NET, VB.NET, Python, LabVIEW and any other platform supporting standard BSD sockets.

PBA.pro can also function as a Test Executive as it includes our Test Manager feature which allows convenient grouping of all tests with complete automation. Reports are auto-generated, customizable and can be distributed directly to your verification body.

A practical example of test plans using the PBA.pro Python Scripting Engine and the Test Executive is the execution of the MIL-STD-1553 RT Validation Test Plans for SAE AS-4111 and AS-4112. Both of these plans define the electrical and protocol testing for MIL-STD-1553 remote terminal devices that operate on a MIL-STD-1553 databus. The standard defines the test setup, and the expected measurement values and limits, but does not specifically dictate what equipment to be used for the testing, or how to create the conditions necessary to produce the results. AIM offers MIL-STD-1553 modules with the Digital Scope option, and PBA.pro advanced simulation and analysis software. The AS4112 (and AS4111) test plans are available as Python Scripts. AIM has supplied many integrated systems including the before mentioned components, either integrated directly by AIM or by the by the end user. AIM has also developed scripts that are optionally available for ARINC-664/AFDX® End System and Switch validation.

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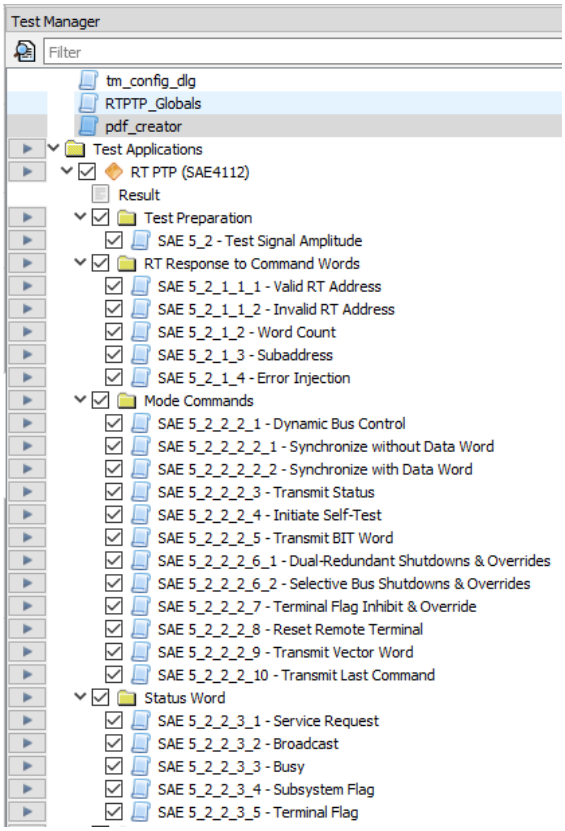

Summary:

With so many different protocols, vendors, and test needs it can be overwhelming deciding on how to handle each application. AIM can simplify matters and cover the entire range of your needs. Contact AIM and tell us about your application needs and we would be happy to schedule a free demo of the software for your exact needs.